

ON
INJURIES
AND
DISEASES
OF
THE KNEE-JOINT
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INJURIES AND DISEASES

OF THE

KNEE-JOINT.

INJURIES AND DISEASES

OF THE

KNEE-JOINT,

AND

THEIR TREATMENT BY

AMPUTATION AND EXCISION CONTRASTED.

THE JACKSONIAN PRIZE ESSAY OF THE ROYAL COLLEGE OF
SURGEONS OF ENGLAND FOR 1865.

BY

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TO
SIR WILLIAM FERGUSSON, BART., F.R.S.,

PROFESSOR OF SURGERY AT KING'S COLLEGE,
AND SERGEANT-SURGEON TO HER MAJESTY THE QUEEN,

This Work

IS RESPECTFULLY DEDICATED,
IN ADMIRATION OF HIS GREAT SURGICAL SKILL,

AND
IN REMEMBRANCE OF MANY KINDNESSES RECEIVED
AT HIS HANDS,

BY THE AUTHOR.

P R E F A C E.

THE ROYAL COLLEGE OF SURGEONS announced as the subject for one of the Jacksonian Essays for 1865 “The diseased conditions of the knee-joint which require amputation of the limb, and those conditions which are favourable for excision of the joint.” My dissertation on this subject was fortunate enough to obtain the Prize, and in the year 1866 the Essay was published in the ‘British Medical Journal.’ I trust, however, that I shall not be considered presumptuous in reproducing it in its present form.

Some additions have been made to the original Essay, particularly to that portion which treats of gunshot wounds of the knee-joint. Further statistical records of the operation of Excision of the Knee have also been added, which, it is hoped, may tend somewhat to diminish the prejudice which still exists against this operation.

I must acknowledge with gratitude the very

valuable assistance which I have received from my friends Mr. Henry Smith and Mr. Christopher Heath, and also from Mr. Delagarde and Mr. Kempe of Exeter. My thanks are also due to Sir William Fergusson, Dr. Druitt, Mr. Canton, and Dr. Patrick Heron Watson, for the loan of some of the woodcuts which appear in this volume.

WILLIAM PAUL SWAIN.

DEVONPORT; *September*, 1869.

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ON DISEASED CONDITIONS

OF THE

KNEE-JOINT.

CHAPTER I.

GENERAL ANATOMY OF THE KNEE-JOINT.

The Femur—The Tibia—The Patella—Growth of the Bones—Muscles and Tendons—Action of Muscles—The Ligaments—The Cartilages—The Synovial Membrane—Vascular and Nervous Supply.

The Knee-joint, the largest and most complicated articulation in the body, belongs to that class of joints termed ginglymoid. Its osseous structure is derived from the lower extremity of the femur, the upper extremity of the tibia, and the patella.

The Femur, at its lower extremity, terminates in the external and internal condyles, continuous with one another in front, but divided posteriorly by a depression called the intercondyloid fossa. Of the two condyles, the external presents the larger articular surface in front; but the internal is longer than the external.

This anatomical peculiarity—viz. the difference in length of the two condyles—deserves especial notice in reference to the operation of excision of the knee-joint. Humphry, in writing on the lower extremity, makes the following remarks:—"When the lower ends of the two thigh bones are placed near together upon a level surface, as when they rest upon the upper surfaces of the tibiæ in the erect position, their shafts slant away from one another, so that each forms an angle of about 15° with a perpendicular line falling between them. The degree of obliquity varies a little; it is, as a general rule, greatest in women and in short persons, *i. e.* in those persons in whom the angle of the neck with the shaft is smallest. The inner condyle of the femur is longer than the outer, in order to render the articular surface at the knee level."* It is most necessary to bear this fact in mind when sawing the bone through, as one of the steps in excision of the joint; and when we come to consider that operation I shall refer more fully to the point.

Each condyle possesses a large articular surface covered with cartilage, on either side of the fossa, for articulation with the tibia; whilst between these two surfaces, in front, lies the patellar articular surface, over which the patella plays. It is of some practical bearing to note that the external articular condyle is of the two the more prominent, as in diseased conditions of the joint the patella is frequently found attached to this surface. On each

* Humphry 'On the Human Skeleton.' p. 475.

side of the condyles are rough surfaces for the attachment of the external and internal lateral ligaments; and on the side of the external condyle is also a smooth groove terminating in front in a depression, from which the popliteus muscle takes its rise. It is of importance to observe particularly the origin of this muscle, as in noticing certain pathological conditions of the joint we shall have again to refer to it.

Development.—An ossific nucleus is not deposited in the lower extremity of this bone until the eighth or ninth month of foetal life; and although this is the first of its epiphyses in which bone is deposited, yet it is the last to become united to the shaft, complete union not being accomplished before the twentieth year.* Barwell relates a strumous case in which union did not take place until the twenty-fourth year.†

The Tibia.—The head of the tibia presents two condyloid surfaces corresponding to the articular condyles of the femur. Between them rises the spine, and at its base, one in front and the other behind, are the depressions which give attachment to the crucial ligaments and semilunar cartilages of the joint. On the outer side of the head is the external tuberosity marked posteriorly by an articular surface for the head of the fibula; and on the inner side is the internal tuberosity, marked by a groove for the insertion of the tendon of the semi-membranosus muscles. In front is the anterior tuberosity,

* Humphry 'On the Human Skeleton,' p. 476.

† Barwell, 'Diseases of the Joints,' p. 6.

giving attachment by a rough surface below to the ligamentum patellæ, and presenting above a smooth surface over which is placed a bursa. Behind is the rough popliteal line passing obliquely downwards and inwards from the outer tuberosity of the head, for the attachment of the popliteus muscle. The head of the tibia projects backwards and somewhat overhangs the shaft. This should be remembered in sawing through the bone.

Development.—There is a special nucleus for the head of the tibia which does not appear until some weeks after birth. This epiphysis includes the anterior tuberosity within its boundary, a point of considerable importance to the surgeon, although there is sometimes a special nucleus at this point. At the age of twenty years, it is frequently not yet united to the shaft of the bone.

The Patella is a sesamoid bone developed in the tendon of the quadriceps extensor muscle. It is sub-cutaneous ; its under surface being coated with cartilage for articulation with the patellar articular surface of the femur. It is attached by the ligamentum patellæ to the anterior tuberosity of the tibia. At birth this bone is cartilaginous, and an ossific deposit appears about the third year.

The Growth of the Bones.—Before leaving the consideration of the bones entering into the formation of the knee-joint, it may be well to refer to the very important subject of their growth. It is well known that long bones grow longitudinally by successive additions to their extremities. An ossific nucleus

being deposited in the epiphysal cartilage, the bony matter extends in all directions, stopping short, however, of the edge of the cartilage, and leaving two layers—one, the articular cartilage, between it and the joint, and the other, the epiphysal junction, between it and the shaft of the bone.

The further researches of Humphry, Ollier, and others, show, moreover, that the larger ends of the long bones, and those in which the epiphysal cartilages remain the longest, grow the most. Thus, at the lower end of the femur, where the epiphysal cartilage is the last to be united to the bone, the growth is most rapid and prolonged. Much, if not all, of the growth in length at the upper epiphysis is lost, owing to its extreme obliquity; it is, therefore, of great importance to preserve the longitudinal growth of this bone. In the case of the tibia, the longitudinal growth being at both epiphyses is all gain;* but here, too, the most important growth is at the larger end, in connection with the knee-joint. Ollier points out that, whereas removal of the epiphysal ends of the humerus and ulna at the elbow-joint interferes but little with the subsequent growth of the limb, yet that the analogous proceeding at the knee-joint, removing, as it does, the two principal sources of longitudinal growth, must materially interfere with the after proportions of the limb.

The Muscles and Tendons in connection with the knee-joint, which are more or less involved either in

* Hodges 'On Excision of Joints,' p. 157.

morbid conditions or operative procedures, next require notice. Passing anteriorly to its insertion in the anterior tuberosity of the tibia is the tendon of the quadriceps extensor femoris, beneath which muscle is the subcrureus, extending from the lower part of the anterior surface of the femur to the synovial membrane of the knee-joint.

On the inner side, a little below the insertion of the quadriceps, is inserted the tendon of the sartorius, and beneath this the tendons of the gracilis and semitendinosus. The semimembranosus is inserted by three slips, one passing to the inner side of the tibia, one to the popliteal fascia, and one to the posterior ligament; and, with the semitendinosus, it forms the inner ham-strings. The biceps femoris, forming the outer ham-string, passes to its insertion in the head of the fibula by two slips, between which passes the external lateral ligament, a bursa being interposed. Posteriorly, the gastrocnemius arises from the condyles of the femur. Under the inner head, separating it from the tendon of the semimembranosus, is a synovial sac, which sometimes communicates with the knee-joint. The plantaris takes its origin from above the external condyle and the posterior ligament of the knee-joint. The popliteus, as before remarked, arises from a depression in front of the popliteal groove on the external condyle within the capsule of the joint, and is in contact with the external semilunar cartilage.

Action of the Muscles.—The quadriceps extensor extends the knee-joint; the ham-string muscles flex

it. The inner ones with the popliteus act as rotators inward, especially in flexed conditions of the joint. The outer ham-string, the biceps, acts as an external rotator. The subcrureus is supposed, in extension of the joint, to pull up the synovial membrane, and prevent its being pressed between the patella and the femur.

The Ligaments of the knee-joint are the external, internal, and the posterior, or ligament of Winslow; this latter one being strengthened by slips from the tendons of the semimembranosus, the popliteus, and the heads of the gastrocnemius, and presenting a strong and firm partition between the joint and the popliteal vessels and nerves which lie upon it.

The ligamentum patellæ, although strictly the tendon of the quadriceps, may be considered one of the ligaments of the knee-joint. The attachment has been already noticed. Between it and the top of the tibia a bursa is found.

The crucial ligaments are within the joint. The anterior, arising from the depression in front of the spine of the tibia, passes backwards and upwards to be inserted into the inner and posterior part of the external condyle of the femur. The posterior, arising from the depression behind the spine of the tibia, passes forwards and upwards to be attached to the intercondyloid hollow and inner condyle of the femur.

The transverse ligament is a slight band of membrane connecting the interarticular fibro-cartilages of the knee-joint in front.

The capsular membrane is a fibrous tissue occupying the space between the ligaments. It is specially present between the sides of the patella and the femur, and covers the condyles of the femur beneath the gastrocnemius.

The Semilunar Cartilages are placed on the articular surface of the head of the tibia. They are surrounded by synovial membrane. The outer convex borders are thick, whilst the inner concave borders are bevelled down to a fine edge; the surface of the tibia within the borders being uncovered by them.

Articular Cartilage.—The entire articular surfaces of the femur, tibia, and patella, are coated by a layer of cartilage varying in thickness from one-sixteenth to one-seventh of an inch. As has been already noticed in considering the growth of bone, this cartilage is the layer of unossified cartilage which exists between the deposits of bone in the epiphysis and the joint. It is a tough elastic material, permeated neither by vessels, nerves, or lymphatics. Exposed as it is to continual wear and tear at its free surface, there is special arrangement made for its repair. It is attached, or is rather continuous with the bone; but that portion of bone with which it is immediately in contact, the articular lamella, consists, according to Barwell, of a series of minute tubes running forward to the cartilage surface, through which passes the nutrient fluid from the bone to the deep surface of the cartilage. It is very doubtful as to whether the surface

of articular cartilage is covered with any membrane. It is more than probable that the peculiar arrangement of the cartilage corpuscles has led some observers to the conclusion that the free surface of the cartilage was covered by epithelium. It has been pointed out that these corpuscles, as they approach the free surface, gradually change their position; from being perpendicular, they gradually assume a horizontal position, until, at the free surface of the cartilage, they form several layers of corpuscles placed horizontally one on another.* By this arrangement, a continuous growth of cartilage takes place from the attached surface to compensate for the loss at the articular surface.

The Synovial Membrane of the knee-joint encloses the largest synovial cavity in the body. It forms a large sac beneath the quadriceps, and invests the entire circumference of the lower end of the femur. It is thence reflected on to the tendons of the gastrocnemius behind. A process invests the crucial ligaments, the upper and lower surfaces of the semilunar cartilages, and thence passes to the tibia. Another process passes down on the popliteus, and sometimes is blended with the fibular joint. It sends processes named "ligamenta alaria" between the tibia and patella; and another process, "ligamentum mucosum," through the joint to the front of the intercondyloid fossa. These processes lie on and enclose fat, which fills up the numerous interstices in the joint, and forms a sort of pad on which the synovial

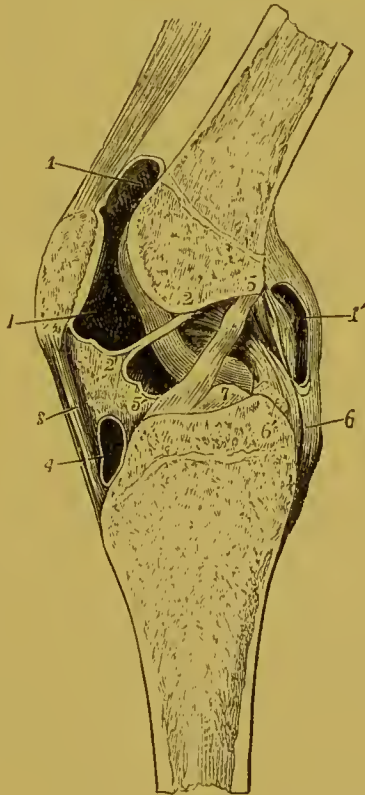
* Barwell 'On Diseases of the Joints,' p. 12.

membrane rests. A variety of opinions have been expressed as to the prolongation of the synovial membrane over the articular cartilage. Barwell states that it is his conviction that the cartilage is not covered by this membrane, but that it is lost near its edge : whilst, on the other hand, Toynbee has proved its existence in the foetus. Price states that he is convinced that more than once he has traced a prolongation over the cartilaginous surface ; and that, in some diseased conditions of the articulation, it can be demonstrated.* Seeing, however, that the resemblance between cartilage structure and the structure of synovial membrane is very great, and that diseased conditions extend rapidly from one to the other, Barwell's views upon this point are probably correct, and the synovial membrane should be regarded, not as a closed sac, but as a simple tube terminating at either end at the edge of the articular cartilage. The loose arrangement of the membrane, and the plentiful deposit of soft fat and subsynovial tissue, seem especially to provide against the bruising and injury to which it would otherwise be subjected ; and it appears to me that this arrangement would be materially interfered with if the synovial membrane were prolonged tightly over prominent portions of bone such as those found in the knee-joint. The accompanying woodcut from 'Quain's Anatomy,' admirably illustrates the extent and connexions of the synovial membrane of the knee-joint. It represents a

* Price 'On the Knee-joint,' p. 7.

vertical antero-posterior section of the left knee-joint seen from the left side. 1, is the large sac beneath the quadriceps investing the lower circumference of the femur; 1', being an opening in the sac at its posterior aspect; 2, 2', ligamentum mucosum; 3, ligamentum patellæ; 2', 3, subpatellar fat; 4, bursa above the insertion of ligamentum patellæ; 5, 5', anterior crucial ligament; 6, lower part of posterior ligament, the upper part of which is towards 2; 6', 7,

FIG. 1.



the spine of the tibia. This drawing is taken from a young subject, eighteen or nineteen years old, and illustrates the extent and position of the epiphyses.

The vascular supply to the joint is derived from an anastomotic branch of the superficial femoral, branches of the popliteal, and a recurrent branch of the anterior tibial artery.

The nervous supply is obtained principally from the internal popliteal nerve, and a small twig from the obturator nerve may be traced to the back of the joint.

CHAPTER II.

MORBID CONDITIONS OF THE KNEE-JOINT.

Affections of the Synovial Membrane, and the Articular Cartilages—Acute Synovitis—Subacute Synovitis—Chronic Synovitis—Gelatiniform Degeneration—Rheumatic Synovitis—Suppuration in the Knee-joint—Inflammation of Cartilages, Acute and Chronic.

It seems not to be within the scope of this essay to treat systematically of all the various morbid conditions connected with the knee-joint, but rather to single out for observation those more serious lesions which require the formidable procedure either of amputation through the thigh or excision of the joint. It is, however, impossible to perform this task without noticing some of those diseased conditions which, whilst in themselves not requiring either amputation or excision, yet may progressively lead on to such a thorough disintegration of joint-material as to necessitate either the one or the other of these modes of relief.

Observing the order of frequency in which the different tissues of the knee-joint become involved in disease, it will be necessary to consider first of all those morbid conditions which take their origin in the synovial membrane; nor, when we consider

the structure and functions of this membrane in the knee-joint, its extent and exposed position, is it a matter of surprise that it should be peculiarly obnoxious to disease.

Acute Synovitis arises from a variety of causes, foremost amongst which may be mentioned violence to the joint, rheumatic poison, gonorrhœa, and pyæmia ; or it may arise spontaneously, without any known cause. However different may be these causes, yet the local condition to which they all give rise is nearly identical, and the course of the disease much the same. The advent of the attack is marked by great pain, heat, and swelling of the whole joint from the distension of the synovial sac with effusion. This swelling is principally found in front of the thigh under the quadriceps, on either side of the patella, and sometimes in the popliteal space, although I have never seen the latter ; the knee assuming a semiflexed position, thereby giving the largest possible capacity to the synovial sac. The constitutional symptoms are also well marked. The flushed and anxious countenance, dry skin, furred tongue, and rapid pulse, all point to a severe inflammatory process going on in a most important part of the body. If this state of things be allowed to progress, suppuration will commence ; the skin becomes involved ; shortly the matter points and bursts, opening the joint-cavity ; profuse suppuration continues and increases ; and pain and exhaustion soon destroy the patient. The pathological changes which take place in the synovial tissue

itself during this period are well marked. The first effect of inflammation is increased vascularity of the subsynovial tissue, accompanied by increased secretion of synovia into the joint. There seems to be no evidence of an arrest of secretion in this early stage. The experiments of M. Richet go to prove that this is not the case; and he asserts that, having opened the joints of dogs, he observed hour by hour the secretion of synovia taking place. The increased vascularity of the membrane is particularly marked in its vascular processes (ligamenta mucosum et alaria). At a later period, shreds of lymph are found floating in the secreted fluid; and sometimes if the effusion be very rapid, it is tinged with blood. As the disease progresses, the inner surface of the membrane is covered with a substance resembling granulations, giving rise to villous or fringed processes; and at the same time it becomes thickened externally, and a deposit of yellow serum takes place beyond it. The fluid effused into the joint becomes turbid; pus is formed, at first in small quantities; but in time the fluid becomes pure pus. At this period, and rarely before, the cartilages become involved; they lose their polish, and spots of ulceration commence. Sometimes these ulcers are large, with defined sharp edges; sometimes they present a worn-eaten appearance. Soon the bone is laid bare; the absorption of cartilage progresses more rapidly, until frequently the entire surfaces of the femur and tibia are denuded. It is astonishing how soon after the first advent of in-

flammation, destruction of the cartilages sometimes commences. Barwell quotes a case in which he examined the knee-joint of a patient who died on the fourth day of the attack, when an ulcer of the size of a sixpence was found on the inner condyle of the femur. The osseous structure becomes involved, and caries sets in; abscesses form all around the joint; the ligaments become softened and relaxed; and nothing short of the removal of the disease by a capital operation can rescue the patient. In this statement, as in others of a like character, I must not be understood to preclude the possibility of cure. In acute suppuration of the knee-joint, especially after injury, free incisions into the joint, to evacuate the pus, will give a very fair chance of ankylosis. This practice is, I fancy, fallen into too much disuse in the present day.

Subacute Synovitis.—This affection is of all others the most common to the knee-joint. It is less intense, and accompanied by far less serious constitutional derangements, and of course with far less serious consequences, than the acute form. It is occasioned by general causes or local injury, and commonly yields rapidly to appropriate treatment. It commences with pain in the joint, and swelling soon comes on, bulging out the synovial sac; the joint assuming the semiflexed position. If unchecked, this disease either runs into the chronic variety, becoming then much more troublesome to cure, or else, especially in strumous subjects, gradually spreads to the other tissues of the joint, involving

cartilage and bone, and eventually destroying the entire joint.

Chronic Synovitis.—This form of disease is, perhaps, more difficult than either of the others correctly to diagnose; but it is of the utmost importance that the surgeon should form an exact estimate of the peculiar changes which may be slowly going on within the joint. Chronic synovitis, pure and simple, may be the result of either of the previous forms of synovial inflammation, or it may originate without any exciting cause. If the latter be the case, it should arouse suspicion as to whether, as is often the case, it is not connected with a constitutional habit of body, such as the rheumatic, scrofulous, or syphilitic. Of this last condition I had under my care

FIG. 2.



in hospital a curious example in a case of effusion into

both knee-joints (Appendix, Case 99). The patient was a young woman who was admitted for interstitial corneitis. She had peg-top teeth and suffered from undoubted inherited syphilis. The effusion came on after her admission, and the accompanying wood-cut (Fig. 2), taken from a cast of one of the knees, shows very well the appearance of a knee-joint with a largely distended synovial sac.* Chronic synovitis may be one of a series of attacks of inflammation, each one leaving a joint, previously damaged by disease, in a worse condition than before. In any case, swelling from gradually secreted synovia, and a remarkable absence of pain or tenderness, are the prominent symptoms. This absence of pain, as Price has well pointed out,† is very deceptive, and likely to mislead the surgeon as to the severity of the case with which he is dealing. I have seen remarkable instances of this fact—cases where there has been an almost total absence of pain, and yet I have found the entire apparatus of the joint destroyed, and the ends of the femur and tibia extensively diseased. Considering this disease apart from all constitutional diathesis, its great danger arises when it recurs constantly. Once let a knee be subjected to a few attacks of chronic inflammation, and in all probability there will be a constant recurrence of the disease. The synovial membrane becomes vascular and thickened, and granulations are de-

* A similar case is reported in the 'Ophthalmic Hospital Reports,' vol. iv, p. 299.

† Price, 'On the Knee-joint,' p. 16.

veloped upon it. The effused fluid becomes fibrinous; false membranes are formed, which rapidly become organised; the subsynovial tissue is thickened; the cartilages, and subsequently the bones themselves, are involved.

Gelatiniform Degeneration of Synovial Membrane.—

By some authors this disease is named strumous or scrofulous synovitis. Without denying that struma may be a predisposing cause to this peculiar pathological condition, and that the two are frequently found associated, yet I believe it is the experience of most surgeons that gelatiniform degeneration of the knee-joint may exist without any strumous diathesis in the patient; and Sir B. Brodie himself states, in many of the illustrative cases which he gives, that the patients were in other respects in good health. It would be better to look upon this peculiar disease as one distinct from strumous synovitis, which should rather be classed with those cases of chronic inflammatory conditions of the synovial membrane which we have been just considering. Brodie makes two statements which go very much to strengthen this view. First, he states that, although the disease progresses slowly, and remains for a long time in an indolent state, yet ultimately it has always terminated in the destruction of the joint;* and, again, he

* In the last edition of Sir Benjamin Brodie's works, I find the following modification of his views respecting this disease. "I formerly had been led to regard the disease as one which does not admit of a cure, and I still see no reason to doubt the correctness of this opinion respecting it in its more advanced stages. My later experience, however, leads me to think more favorably of it, if it be attended to at an earlier period."

goes on to say: "It is a remarkable circumstance that this affection of the synovial membrane is rarely met with, *except in the knee*. I have never known an instance of it in the hip or shoulder."* Now, in neither case can we say this of that synovitis which is connected with the strumous diathesis.

I know of no better description of this disease than that given by Brodie himself, and which is quoted, or very closely followed, by all writers on the subject. He says that the synovial membrane "loses its natural organisation, and becomes converted into a thick pulpy substance, of a light brown, and sometimes of a reddish-brown colour, intersected by white membranous lines. As the disease advances it involves all the parts of which the joint is composed, producing ulceration of cartilages, caries of the bones, wasting of the ligaments, and abscesses in different places." He classes this peculiar deposit with that of tubercle of the lungs, scirrhus of the breast, or the medullary sarcoma of the testicle. Barwell, however, who treats of the disease as strumous synovitis, considers that the pulpy substance is but a further development of those granulations which appear on the surface of synovial membrane as one of the results of chronic inflammation, contending that "the only real difference consists in the degree of development which the granulation undergoes."† In addition, however, to the reasons above stated for considering this a distinct disease

* Brodie, 'On the Diseases of the Joints,' chap. iii. sec. 1.

† Barwell, 'On Diseases of the Joints,' p. 106.

there are others to be deduced, which, I think, satisfactorily prove this to be the case. Unlike that form of chronic synovitis which degenerates into or arises from strumous disease, this gelatiniform degeneration is more frequently to be found amongst adults. The swelling, which is the first symptom, is of a peculiar character. It does not convey the sense of fluctuation to the touch, which the ordinary effusions of synovial inflammation do; it is a swelling rather of a doughy, semi-elastic character. Nor does it assume the same form. It is more general and uniform; the bulging of serous effusion is absent; and the whole joint assumes a regular, globular shape. A difficult point of diagnosis may here arise. The successive layers of organised lymph deposited on the synovial membrane, and on the tissues surrounding the joint, by repeated attacks of chronic synovitis, may nearly obliterate the joint-cavity, and give to it very much the same shape and feel as that above described. The history of the case, if carefully collected, will, however, generally enable the surgeon to decide. The difficulty of diagnosis, however, in these cases is well shown by reference to a case recorded at p. 38 under the care of the late Sir William Lawrence, where the medical staff were under the impression that it was a case of pulpy degeneration, the event showing that the swelling was in no manner connected with the joint, but was a cyst in the lower articular extremity of the femur.

Another point of importance, which will assist in

diagnosis, is the presence of pain. In my remarks on chronic synovitis, I particularly called attention to the frequent *absence* of pain. In pulpy degeneration, the presence of pain, not the jumping intermittent pain of diseased cartilage, but a constant, dull, heavy, gnawing pain, is the rule. Sir W. Fergusson has also noticed an important point, namely, that the elasticity resulting from the great thickening of the synovial membrane is such that, after pressing the bones together, they resume their former position. One other point, which I do not remember to have seen noticed, but which, I am sure, is characteristic of this disease, is this: that whereas, in chronic synovitis, the knee assumes the semiflexed position, owing, as before stated, to the distension of the synovial sac, and, if neglected, becomes stiffened in that position, in pulpy degeneration this is seldom or never the case; and in many instances, even when the disease is in an advanced stage, there is considerable mobility about the joint.

The progress of this disease towards complete destruction of the joint is analogous to that before described as arising from acute or chronic inflammation. The cartilages become overlaid with the diseased tissue, soon begin to ulcerate, and finally altogether disappear. Pus is rapidly generated in the joint. The denuded bone is soon involved in the disease; sinuses penetrate the periarticular tissue, and lay open the joint; and the constitutional symptoms which accompany these processes compel

the surgeon to have recourse to removal of the disease by operative procedure.

Rheumatic Synovitis.—Acute rheumatism is a disease which calls more especially for the physician's treatment. Its local manifestation in the knee-joint is, however, familiar to surgeons, and partakes more or less of those forms of acute or chronic synovitis which have already been considered. It is of rare occurrence for it to run on to total disintegration of the joint; but, as such instances do occur, it is right that we should notice the condition. At the commencement of the attack, a large quantity of synovia is secreted. This shortly becomes milky, and shreds of lymph are found floating in it. The synovial membrane becomes red and thickened, and eventually granular. The cartilages ulcerate, and undergo fibrous degeneration. The tissues round the joint are thickened by infiltration. At an advanced stage crepitus can often be detected on moving the tibia on the femur. Sometimes, in gouty cases, the fluid in the joint contains gritty matter, consisting of urate of soda. The inflammatory condition induced by acute rheumatism may, however, sometimes lead to suppurative action in the knee-joint; as may be seen by the following case under the care of Mr. Solly in St. Thomas's Hospital.

A man, æt. 44, was admitted in September, 1861. He had taken cold when thatching with wetted straw, and was seized with pain on the left side of the body. The left knee was especially affected, and abscesses formed round the joint. Eventually the abscesses communicated with the joint; the

limb was amputated, and the joint was found to be entirely destroyed.*

Traumatic Synovitis will be referred to when considering wounds and injuries of the joint.

Suppuration in the Knee-joint.—This condition has been so frequently referred to as one of the results—the most fatal result, perhaps—of the various inflammations of synovial membrane, that I think it right at this point to refer to it more in detail. It is a matter of extreme difficulty to say whether the effusion in a joint be simple synovia, or whether it be pus. In fact, the mere touch cannot decide the question. The occurrence of a rigor, increased tenderness in the part, constant throbbing pain, a typhoid condition in the patient, all these, especially the first, will lead one gravely to suspect the advent of suppuration in the joint-cavity. If we have reason to think that pyæmic poisoning affects the patient, we can have little difficulty in concluding that pus has been secreted. Its first advent into the joint is a matter of some curiosity. It has been thought that, in the lesser inflammations, pus is never formed; and that, if the inflammatory process be severe enough to produce it, it is seldom absorbed. Dr. R. Volkmann,† however, has stated as the result of his researches, that the thick lining of pavement epithelium on the inner surface of the capsular ligament, under the influence of catarrhal

* 'Lancet, 1861, vol. i, p. 1.

† 'Archiv für Chir.,' vol. i, part 2, p. 408. Sydenham 'Year Book,' 1861.

inflammation, secretes pus-cells; and he thus accounts for the turbidity of the effused fluid which is often found in synovial inflammation. He moreover asserts that this pus may disappear by disintegration of the pus-cells and absorption. If the deeper parenchymatous tissues be affected, then a severe form of inflammation is produced, and the secreted pus maintains a pyogenic state in the synovial membrane. The cartilages are very soon affected by ulceration; and the bone, denuded of its cartilages, in turn becomes diseased. If the pus be not evacuated by the surgeon, it will soon ulcerate through the synovial membrane, and, burrowing in various directions, open externally. In a case where Mr. Holt, of the Westminster Hospital, amputated a thigh, the pus had burst through the synovial membrane round the tendon of the popliteus muscle, and, finding its way beneath the expansion over it to the inner side of the tibia, pointed at the oblique line. I am not aware that this pathological condition has ever before been noticed; and I am indebted to Mr. Christopher Heath for having directed my attention to it in a preparation of a knee-joint, which accompanied this essay. Suppuration in the joint will be again referred to in the chapter on Wounds, Injuries, and Deformities of the joint.

Diseases of the Articular Cartilage.—It is almost certain that disease never commences in the articular cartilage. Originating either in the synovial membrane or in the osseous structures, disease is communicated to the cartilages. It was the generally

received notion—one propounded and supported by Sir B. Brodie—that active changes took place in the cartilages of joints by the intervention of vessels permeating their substance. The entire absence both of vessels and nerves has, however, been demonstrated; and this fact has led many into the error of supposing that inflammation cannot take place in articular cartilages. Virchow was the first to confirm the fact, that changes in cartilage were inflammatory. Goodsir and Redfern demonstrated the changes which took place in the cell-growths; and Barwell has entered minutely into the question in a paper, “On the Nutrition and Inflammation of Articular Cartilages.”* He divides ulceration of cartilage into inflammatory and degenerative; the latter being again divided into fatty and granular.

Inflammation of cartilage consists in the rapid generation of cells from those previously existing. If the inflammation be acute, the hyaline substance is absorbed, and an ulcer results; the cells set free falling into the joint, and multiplying as pus-cells. If it be less active, the hyaline substance is converted into fibre.

In *fatty degeneration*, the corpuscles are filled with oil; and the hyaline substance becomes fibrous.

In *granular degeneration*, the hyaline substance again becomes fibrous, and the corpuscles present opaque spots on them, and ultimately shrivel up and form scales on the free edges.

* ‘Med.-Chir. Review,’ October, 1859.

In certain *chronic conditions of inflammation*, the cartilage-cells become *fibre-cells*, and form a sort of coarse areolar tissue. This tissue, meeting with the granulations on the synovial membrane, forms connections with it, and gives rise to false anchylosis. Mr. Aston Key, who asserted* that cartilage became disintegrated by its contact with the fringed vascular processes of the synovial membrane, was evidently misled by these appearances. It is a condition most frequently found when the disease commences in the synovial membrane. When, however, it arises in the osseous structure, as shown in a preparation of a knee-joint, excised by Mr. Wood, of King's College, which accompanied this essay, the following process takes place. A portion of bone becomes inflamed, and over that spot degeneration and separation from the bone takes place, owing to the nutritive supply being cut off; the portion of cartilage being sometimes thrust into the joint-cavity. All round this spot, inflammation, and eventually ulceration is set up, and thus, in a short time, the whole joint becomes affected. The pain and starting of the limb which accompany ulcerations of the cartilage of the knee-joint, were at one time referred to the cartilage itself, but are now understood to arise from the exposure of the bony structure by the removal of the cartilage. Sir B. Brodie writes that he is "inclined to the opinion that the increased sensibility in these cases is in the bony plate beneath the cartilage rather than in the cartilage itself; and that the presence

* 'Med.-Chir. Trans.'

of severe pains, with involuntary startings of the limb, is always to be regarded as a sign of the bone partaking in the disease." We may be pretty sure that simple degeneration or ulceration of cartilage will in itself give little or no indication of its presence. When active symptoms show themselves, extensive mischief has already been done in the joint. If the disease has commenced in the bone, and involved the cartilages, we may expect severe symptoms rapidly to supervene; a condition which will be further noticed when treating of the diseased condition of the osseous structures entering into the joint.

CHAPTER III.

MORBID CONDITIONS OF THE KNEE-JOINT CONTINUED.

Diseased Conditions of the Bones forming the Knee-Joint, and the Tissues surrounding it.—Acute Inflammation of Bone.—Chronic Inflammation.—Tumours at the Articular Extremities.—Diseases in the Ligaments, Muscles, and Bursæ, around the Joint.

Acute Inflammation may attack the articular extremities of the femur or tibia, and may either involve their entire substance, or be confined to a small locality. It may arise in previously healthy tissue, or supervene on old and long standing disease. If acute inflammation attacks the entire spongy portion of either of the bones, the symptoms are most urgent, and the results disastrous. The disease commences with severe rigors, rapid pulse, hot dry skin and furred tongue, intense pain in the parts, with great swelling and hardness. Soon the swelling begins to soften, and suppuration takes place. Delirium sets in at an early period, and coma rapidly supervenes. The periosteum is found separated from the bone by a large deposit of pus; the bone itself is soft, and infiltrated with pus, and the muscular attachments are separated. The symptoms are so

rapid, that it is difficult to determine at what exact period the joint becomes affected. That it is very soon involved and destroyed, there can be no doubt. Stromeyer states that he has frequently seen it arise in a joint affected with chronic inflammation, in which some accident had given rise to this frightful disease, which he thus describes :—

“The capsule of the joint is destroyed, the soft parts in the neighbourhood gangrenous; the ligaments, muscles, and cartilages have all detached from the bone; and the large cavity thus left is filled with brown putrid pus.”

Dr. Klose gives seven cases occurring in young persons, where the lower epiphysis of the femur was separated during the course of this disease. Happily, so urgent a form of disease is of rare occurrence; but there can be but one opinion that, when it does happen, it requires the prompt and decided interference of the surgeon.

Acute inflammation may be limited to a portion of the cancellous structure. It may arise from direct violence, exposure to cold, &c. If it takes place in the centre of the bone, it may result only in a circumscribed necrosis, which becomes surrounded by a vascular membrane, and remains harmless for a very long period. In case this local lesion takes place near the joint, a process of elimination may be set up, terminating eventually in the discharge of the necrosed portion of the bone into the joint, with all the usual accompaniments of suppuration and fistulous openings.

Chronic Inflammation.—Under this heading it appears to me convenient to class all hyperæmic conditions of the spongy textures of the bones entering into the joint which produce thickening of the bone or effusion of serum, and eventually may lead to suppuration and granular degeneration. Like the analogous disease in the synovial membrane, this chronic inflammation may assume different phases when under the influence of various constitutional disturbances. Thus syphilis, although it rarely attacks the joint-ends, and rheumatism, may each give to chronic inflammation its own peculiar tinge; whilst the strumous habit of body produces a condition of the parts so frequently met with, as almost to tempt one to place it apart from chronic inflammations, and assign to it a specific origin and place. Thus Barwell treats only of “Strumous Articular Osteitis,” whilst Price devotes considerable space to the consideration of “Tuberculous Disease” of the joint-ends. Bryant writes :

“I cannot for one moment doubt that the majority of cases which are described by surgeons as strumous or scrofulous disease of a joint, and of the articular extremities of the bones, depend upon a chronic inflammation in the bone.”*

I find that Price quotes this passage, but does not seem to me in any way to controvert it. In fact, Barwell in his chapter on “Strumous Articular Osteitis,” really admits that the disease to which he has given this name is simply a modification of

* ‘Diseases and Injuries of the Joints,’ p. 72.

chronic inflammation of the bone. Having pointed out that hyperæmia may arise in the joint-ends of young children, without inflammation being either present or following, owing to the nutritive activity of ossifying cartilage, he goes on to say :

“It is, however, certain that, in a given number of cases, the congestion predisposes to inflammation, and the merely passive is followed by an active condition. Thus inflammation may be set up in an epiphysal end which was previously in an abnormal state ; and such, in the great number of cases, is the mode in which the disease now under consideration (strumous articular osteitis) commences.”*

In chronic inflammation, there is increased vascularity, not of the bone itself, but of the membrane lining the cancelli. On making a section of a bone thus affected, the entire surface presents an uniform dark purple hue, or, it may be, a mottled appearance. The plates of the cancelli become thickened ; and an effusion of serum of a pinkish colour takes place into their cavities. As the disease progresses, this serous effusion is followed by diffuse suppuration ; and at this stage the cut surface of the bone presents a dirty yellow aspect. The lining membrane of the cancelli now begins to granulate ; the osseous walls become carious, and eventually are altogether absorbed, their place being occupied by a granular mass, surrounded by the external shell of bone. During this period, the periosteum becomes thicker than usual, and, in the early stage of the disease,

* Barwell, ‘Diseases of the Joints,’ p. 224.

deposits new bone around the joint-end. Soon, however, pus is formed between it and the bone; it separates from the bone, sometimes dragging away with it flakes of osseous tissue, and leaving the surface rough and of a worm-eaten appearance. These cavities are filled with pus; the outer shell of bone is softened and broken down, and communications established with the interior. The articular cartilages, in the earlier periods of this disease, are intact; but, as it approaches the articular lamella, they become affected with fatty degeneration, are detached from the bone, and thrown into the joint-cavity. The synovial membrane soon participates; and if, as sometimes happens, a necrosed portion of bone be shed into the joint, violent suppuration and

FIG. 3.



total disorganization rapidly follow. The commencement of the disease is most insidious: there

is a slight limping, hardly noticed; little or no swelling at first, and, if any, situated on one side of the bone only; very slight tenderness. Soon the enlargement of the joint by effusion takes place, and painful startings of the limb occur at night. Spasmodic contraction of the flexor muscles takes place; and the hamstring tendons draw the tibia upwards against the femur, causing acute agony, until, at a more advanced period, dislocation of the tibia backwards is the result. The woodcut (Fig. 3) illustrates this deformity in a somewhat early stage, before extreme flexion has taken place. Profuse suppuration is set up in the periarthicular tissues; sinuses run in all directions; and pain, purulent discharge, hectic, and night-sweats, reduce the patient to the last extremity.

In strumous children this inflammatory condition of the knee-joint is very common, commencing frequently after scarlet-fever or measles. Amongst the lower classes, who have neither the discernment to detect the early inroads of disease, nor the means successfully to combat it when it is discovered, we unfortunately constantly meet with knee-joints entirely destroyed; and the surgeon is frequently obliged to have recourse to some severe operation, in order to save his little patient's life. It is to this particular class of disease that Price has alluded in his section on "Tuberculous Diseases of the Articular Ends of the Tibia and Femur." He writes:

"Morbid deposits of true tuberculous material in

the cancellous structure of the expanded ends of bone is, so far as my own experience goes, an affection of *common occurrence*.”*

Price’s extended study of knee-joint disease, and the intelligence he brought to bear upon the subject, demand extreme deference to any opinions he may have enunciated ; but I cannot help feeling that in this matter he was mistaken. I have never seen a case of pure tuberculous deposit in a joint-end ; and I believe that the “gelatinous material” which Price describes as “*in every respect* analogous to pulmonary tubercle,” is nothing more than the granulations filling the cancelli which I have before described. The hyperæmic condition dependent

FIG. 4.



upon ossification of cartilage becomes exaggerated occasionally, in strumous subjects, into an inflamma-

* Price, ‘On the Knee-joint,’ p. 32.

tion; and the weakened constitution is unable to arrest the mischief once set a-going. It is not needful here to describe the various symptoms attending the progress of this long and wearisome disease. We have to do only with the symptoms and treatment of its last and most fatal condition, and to this we shall recur in the proper place. In a case the particulars of which are given in the Appendix (Case 95), I had lately occasion to amputate a knee-joint presenting all the features of so-called strumous osteitis. The woodcut (Fig. 4) taken from a cast of the limb before amputation shows the external appearance of this condition. The marks on the side of the femur and tibia indicate sinus through which diseased bone could be felt. The bone on section presented an admirable example of general inflammation of the articular end of the femur, with entire destruction of the joint-apparatus. I looked in vain for any deposit of tuberculous matter; but the microscopic appearance of the bone indicated profuse granular deposit, with absorption of the osseous walls of the canaliculi. In adults, the more usual course is to find this disease circumscribed to a spot in the centre of the bone, surrounded by condensed tissue. If the inflammation be more severe, necrosis of the bone takes the place of caries; and the necrosed portion is, as before remarked, sometimes extruded into the joint.

It sometimes happens that circumscribed collections of matter are found in the cancellated structure of the head of the bones. The pain in

these cases is frequently intense, and the joint very soon becomes inflamed, more apparently by continuity of tissue than by any direct communication with the abscess. A case of this sort occurred at King's College Hospital, the history of which will be found in the (Appendix, Case 34), where, upon section of the femur during the operation of excision, an abscess was found in the cancellated structure of the bone. In this case the joint itself was much enlarged and ankylosed in the straight position. In another case (Appendix, Case 43) an abscess was found in each condyle of the femur. The patient suffered intense pain, and had been ill nearly six years.

Tumours involving the Articular Extremities.—These may be either innocent or malignant. If the former, the joint is interfered with simply mechanically; if the latter, the disease, of course, extends to the tissues of the entire joint, and destroys it. The innocent tumours consist of exostoses or of cartilaginous growths. These tumours frequently set up repeated attacks of synovitis in the joint, leaving the synovial membrane thickened and dilated; so that, if the removal of the exostosis be attempted, the joint is very likely to be laid open, and serious mischief ensue. The most usual form of malignant disease is the medullary, which is stated never to begin as a primary disease on the synovial membrane, nor upon the cartilaginous structures. When the entire joint else has been destroyed by this disease, the cartilage has been found intact.* Cysts

* Virchow, 'Cell. Pathol.,' lect. xix.

sometimes occupy the articular ends of the bones. Mr. Stanley amputated a thigh on account of the existence of a cyst in the condyles of the femur, also involving the tibia; and the following interesting case, recorded in the 'Lancet,'* shows how difficult these cases are sometimes of diagnosis. The case was admitted into St. Bartholomew's Hospital in October, 1863, under the care of the late Sir William Lawrence. For some months the knee had been swollen and painful, and was now uniformly enlarged, and measured two inches more in circumference than the other. The swelling seemed confined to the joint and yielded a sense of fluctuation. The surgeons were divided in opinion respecting the nature of the disease, but thought most probably that it was pulpy degeneration of the synovial membrane. The limb was amputated, and on opening the joint it was found to be perfectly healthy. A cavity existed in the femur behind the patella, with nothing intervening but the articular cartilage. This cavity occupied the entire base of the articulating surface of the femur.

Diseases arising in the Tissues around the Knee-Joint.
—We have seen how frequently all the periarticular tissues become involved when disease commences within the joint. It does, however, sometimes happen that the mischief commences external to the joint, which becomes secondarily affected. Sometimes, particularly in rheumatic or syphilitic cases, thick layers of fibrous material are deposited in and

* 'Lancet,' 1863, vol. ii, p. 649.

around the ligaments of the joint, forming a very firm ankylosis. The muscular tissue occasionally undergoes degeneration after the limb has been long confined in a splint for fracture of the thigh, and effusion of blood and serum may take place into the joint, and affect the cartilages and synovial membrane.* The areolar tissue may become inflamed and acute abscesses form in close proximity to the joint. In delicate children this sometimes takes place, and is very apt to implicate the joint, bursting into the synovial cavity, and setting up acute supuration. Erysipelatous inflammation, too, may involve the joint in the surrounding destruction of tissue.

The various bursæ around the joint may become diseased. The one under the tendon of the quadriceps occasionally involves the joint in mischief. Henry Smith, in a note to Price's essay,† quotes a case which occurred at King's College Hospital, where, a seton having been passed through this bursa, violent inflammation ensued, and destruction of the joint took place. The bursa beneath the inner head of the gastrocnemius now and then communicates with the synovial membrane of the joint, and inflammation arising in this bursa may be communicated to the joint-cavity.

* Holmes's 'System of Surgery,' vol. iii, p. 763.

† 'On the Knee-joint,' p. 40.

CHAPTER IV.

WOUNDS, INJURIES, AND DEFORMITIES OF THE KNEE-JOINT.

Punctured and Incised Wounds into the Joint—Foreign Bodies in the Joint—Gunshot Wounds—Dislocations and Fractures—Anchylosis.

THE knee-joint, from its exposed position, is peculiarly liable to wounds and various injuries. If a wound opening the joint be inflicted, its gravity will, of course, depend very much on the character of the incision and the instrument with which it is made. If it be a small puncture-wound, especially if made in an oblique direction and with a sharp instrument, appropriate treatment will generally avoid much damage. If, however, the wound be lacerated, contused, and extensive, the inflammatory condition set up within the joint-cavity is of a most severe character. The inflammation is attended with a great deal of constitutional disturbance and excruciating pain. The entire joint becomes enormously swollen, hot, and painful. Profuse suppuration soon sets in; the cartilages disappear; the joint-ends of the bones are involved; dislocation of the tibia outwards and backwards sometimes taking place, and all the periarticular tissues sympathise with the derangement. Mr. Athol

Johnson in his article "Diseases of the Joints," in Holmes's 'System of Surgery,' remarks "that in wounds of the knee-joint, when suppuration occurs, it often takes place insidiously in the areolar tissue, between the thigh-bone and the muscles which surround it, rather than in the articulation itself. In this way the entire thigh may be inflamed and swollen, and the appearances somewhat resemble those of acute periostitis of the femur."* Free incision into the joint, as pointed out by Gay,† and into the deep tissues of the thigh, if needful, together with perfect rest, and the continuous application of ice, as advocated by Hilton,‡ may do much to save the limb; but at best the joint must remain a damaged one, and it is too frequently the case that the removal of the joint or of the limb becomes a necessity. It will depend much on the constitution and habits of the patient, whether an extreme measure will be required; and, although the joint may be disorganized as the result of a wound, the surgeon should wait to the utmost before he operates, as there is such a great chance of ankylosis occurring, if the general condition has previously been good. Two cases of disorganization of the knee-joint, the result of wounds, under the care of Mr. Henry Smith, at King's College Hospital, illustrate this. In the one the patient was a healthy young man; and, although the joint was so disorganized that

* 'A System of Surgery,' vol. iii, p. 788.

† 'Medical Times and Gazette,' vol. xxiv, p. 546.

‡ 'Lectures on Rest and Pain,' lec. xviii.

amputation was urgently pressed upon him, he would not consent, and ultimately bony ankylosis took place. In the other, a drunken middle-aged woman had her joint disorganized from a wound. Her habits, and the circumstance of her having suffered from delirium tremens, induced Mr. Henry Smith to amputate. In this case, even although every vestige of cartilage was gone, Mr. Henry Smith thought ankylosis would have occurred, had the woman's condition and habits allowed him to wait longer.

It sometimes happens that a foreign body becomes lodged in the wounded joint. Thus, Bauer reports a case of perforating wound of the left knee-joint. The case was submitted to amputation, and a pebble-stone was found in the joint.* The puncture of the knee-joint by a needle—a portion remaining in the joint, although, oddly enough, not of frequent occurrence — may cause serious disturbance, as the following case, related by Mr. Erichsen, will show :

“A young lady on the eve of her marriage knelt down to say her prayers, and felt something prick her knee. She suffered no inconvenience at the time, but after a few days the joint was attacked with arthritis. On consulting Mr. Erichsen, he advised the removal of the portion of needle, which was easily detected sticking out of the joint. This was done; and a day or so after the patient incautiously went about, and in three days was attacked with severe arthritis, terminating in abscess in the joint. Amputation

* ‘Philadelphia Medical and Surgical Report,’ May, 1861, p. 114.

was at one time contemplated, but after many weeks she recovered, with a permanent stiff joint.”*

Another case of wound of the joint by a needle, in which Sir William Fergusson successfully excised the joint, will be mentioned hereafter.

Gunshot wounds of the knee-joint are not frequently brought under the notice of the civil surgeon. An interesting case, which came under the care of Mr. Hutchinson, at the London Hospital, is recorded in the ‘Lancet.’†

A young man was admitted into the hospital having been injured by the accidental explosion of a gun. A charge of No. 6 shot, fired at a distance of twelve feet, had entered the right knee, passed obliquely downwards through the condyles of the femur, and entered the inner side of the left leg behind the head of the tibia. The great vessels and nerves in both legs were supposed to be uninjured, and the left knee-joint was untouched.

Mr. Hutchinson excised the right knee-joint, removing an inch and a half of the femur, and a very thin slice from the tibia, and the patella, which had quite escaped injury, was also removed. The patient died of tetanus on the eighth day.

In the ‘Medical Times and Gazette,’‡ is recorded another case of gunshot injury to the knee-joint which was under the care of Mr. Crompton, in the General Hospital, Birmingham.

* ‘Lancet,’ 1864, vol. ii, p. 690.

† Ibid., 1861, vol. i, p. 387.

‡ ‘Medical Times and Gazette,’ 1861, vol. i, p. 518.

A lad, æt. 19, was admitted on December 26th, 1860, having that morning received the contents of his gun into the left knee-joint. There was a large circular wound over the internal condyle, and one inch and a half below, a larger one over the inner head of the tibia. On introducing the finger into the upper wound, it was found that the shot had entered the substance of the inner condyle, breaking off a portion loose in the joint and, then passing downwards, had grazed the inner head of the tibia.

Mr. Crompton excised the joint in a manner to which I shall again refer, and the patient was discharged cured on April 5th.

After the revolution of June, 1848, in Paris, some striking examples of gunshot wounds of the knee-joint were under M. Jobert's care in the Hospital St. Louis. In one a ball traversed the joint from before backwards, and a cure was obtained without ankylosis. In another the ball passed from behind forwards, and the same good result followed. In the third a ball lodged in the joint, produced violent inflammation with the formation of an abscess by the side of the joint, through which the ball was extracted. A cure was effected, with ankylosis.

In the annals of military surgery are to be found many records of this injury, in some cases affording wonderful instances of recovery. For instance, Trowbridge, in a lecture on gunshot wounds, illustrated by cases which occurred at the siege of Fort Erie in 1814, relates a remarkable case where a ball, having opened the capsular ligament of the knee-

joint, carried away a portion of the condyle of the femur. The patient recovered with partial ankylosis of the joint.*

Another equally remarkable case is reported by Moses in 'Surgical Notes of Cases of Gunshot Injuries occurring during the Advance of the Army of the Cumberland in the summer of 1863.'†

"A sergeant was struck by a bullet on the centre of the left patella. The bullet passed through the bone and, passing outwards and backwards through the articular surface of the outer trochanter, tore the capsule and lateral ligaments. The track of the wound was laid open by free incisions, and the fragments of bone removed at intervals. Warm-water dressings were applied, and in three months the wound was nearly closed and there was some motion in the joint."

The following case is extracted from an account of the wounded of H.M.'s 55th Regiment, admitted into the Field Hospital, September 8th, 1855, by James H. M'Cowan, M.D., Assistant-Surgeon 55th Regiment.

"The patient, a stout, healthy grenadier, W. G—, æt. 29, received a wound in the popliteal space. All that could be seen, on examination of this region, was simply a small orifice, about the size of a sixpenny piece, with inverted edges, and situated about the middle of the space, a little, however, on its outer aspect.

"On introducing the finger, the direction of the wound was found to be immediately forwards; and although the ball itself could not be felt, it was considered highly probable the

* 'American Medical Times,' May 24th, 1861, p. 334.

† 'American Journal of the Medical Sciences,' vol. xlvii, p. 324.

bullet was lodged in the knee-joint. This supposition seemed confirmed by the two following symptoms:—the patient referred the pain he experienced to the inner aspect of the head of the tibia, and the joint, maintained generally in a state of semi-flexion, admitted of very limited motion.

“It was determined to watch the case. On the third day the principal medical officer, on visiting the hospital, examined this case. He said he detected the ball in the joint, and advised the immediate amputation of the limb. Dr. Gair, in my absence, performed the operation, and for the first three days everything went on so favorably as to induce the prognosis of a speedy and good recovery. However, at midnight of the third day, secondary hæmorrhage took place during the patient’s sleep, and before assistance reached the ward he was dead. On examination of the stump, union by the first intention seemed universal, except at the inner corner of the flap, where there was a small cavity, the ligature was found loose in the wound, separated from the artery; the mouth of the femoral artery was quite patent, as if clean cut through, its lips being slightly everted. The ball was found impacted in the semilunar cartilage over the internal head of the tibia. On the corresponding condyle of the femur was a distinct indentation; there was not the least evidence of even commencing synovitis.

“If any case of gunshot injury is suitable for the operation of ‘excision of the knee-joint,’ this was just the case; and I fully intended, if any operation was deemed necessary, to have had recourse to excision. At all events, death by secondary hæmorrhage would have probably been avoided.”

The various dislocations and fractures involving the knee-joint set up more or less serious disturbance. The most serious accident of this kind that can happen, although it is rarely met with, is com-

pound dislocation. So rare is this accident, at any rate in London hospitals, that Sir Astley Cooper, in his treatise ‘On Dislocations and Fractures,’ asserts that he had seen but one case. There is a case reported in the ‘Lancet,’* which was under the care of Mr. Birkett, at Guy’s Hospital. The following is a description of the injury :

“The tibia rested upon the inner and anterior part of the lower end of the femur; the cruceial and external lateral ligaments were torn from their attachments to the tibia, but they were not otherwise lacerated; the external head of the gastrocnemius, plantaris, and popliteus muscles were torn and completely divided, which circumstance accounted for the external condyle being so prominent; the tendon of the biceps was found inserted as usual. The internal lateral ligament was slightly separated from its attachments at either end, but it was not torn across. The popliteal vessels were uninjured; the peroneal nerve rested in front of the external condyle, and was greatly on the stretch, this seeming to have occurred as the result of the condyle having been forced between it and the posterior tibial nerve. The external wound was about three inches in length, and extended across the popliteal space. On introducing the finger into the wound the articular process of the external condyle could be felt. The hæmorrhage was purely venous, and the blood slightly mixed with some synovial fluid. The accident happened by a fall from a ladder. Amputation was performed, and the case terminated fatally on the twenty-second day.”

In the same journal† is a report of compound dislocation of the knee-joint, by Mr. Richards, of

* ‘Lancet,’ 1850, vol. ii, p. 703.

† Ibid., 1866, vol. i, p. 64.

Bryngolwg, Aberdare. The accident, which happened from a fall down a coal mine, on October 3rd, 1866, resulted in amputation on October 7th. The man died on the seventh day. The following parts were found torn:—both heads of gastrocnemius, tendon of biceps, popliteal artery, crucial ligaments, and part of external semilunar cartilage. The popliteal nerves were much stretched, but not torn. Mr. Richards remarks that compound dislocations of the knee-joint are not so rare as is usually considered. Dr. Davies, whom he assisted, has himself had seven cases, in all of which he performed amputation. In four the amputation was primary, in the other three (including the one above alluded to) the operation was secondary. Two of the secondary cases died, one of tetanus, and the other of exhaustion. All the rest recovered.

Cases of simple luxation of the knee-joint seldom produce serious after consequences if ordinary care is bestowed upon the treatment. The injury is, however, sufficiently serious to give rise to considerable anxiety as to the after effects upon the joint. In a case reported in the 'Lancet'* by Mr. Taylor, of Penrith, the head of the tibia was dislocated inwards. The external lateral ligament could be felt ruptured, and the external semilunar cartilage could be distinctly detected lying loose under the skin. At the end of three months the patient could walk without support and without lameness, the semilunar cartilage being reduced in size, and evidently under-

* 'Lancet,' 1855, vol. ii, p. 51.

going absorption. One cannot conceive a better result than this after so alarming an accident as the one just recorded. A somewhat similar case is reported in the 'Lancet,'* as having happened at the Westminster Hospital, where the tibia was violently dislocated outwards. Upon reduction a triangular foreign body was discovered, loose on the inner side of the patella. It does not seem to have been recognised as any portion of the articular cartilage. The man made a very slow recovery, and when discharged from hospital flexion and extension of the joint was performed with pain, and he was obliged to walk with a stick.

Dislocation of the knee-joint sometimes takes place spontaneously. In a paper of Mr. Stanley's, published in the twenty-fourth volume of the 'Medico-Chirurgical Transactions,' this condition is fully treated of. Mr. Stanley quotes the following case under Mr. Wormald's care:

A man, æt. 40, about three years before caught a severe cold, after which his knee became swollen and weak, and there succeeded a very gradual alteration in the form of the joint, unaccompanied by pain or inflammation. The tibia was displaced, so that its head projected fully an inch on the inner side of the internal condyle of the femur.

There is a still more curious case reported in the 'Lancet,'† which was under the care of Mr. Holt at the Westminster Hospital.

* 'Lancet,' 1860, vol. i, p. 595.

† Ibid., 1850, vol. ii, p. 654.

A woman, æt. 70, two years before she came under Mr. Holt's care, whilst walking in the street felt something give way in her right knee, and was forced to sit down on a step. She did not suffer much pain, but was unable to walk. On admission into the hospital the knee was found much swollen, and the tibia was dislocated inwards. The dislocation was easily reduced, but it was found impossible to keep the bones in place, and the limb was cased in gutta percha. The patient had long suffered from tic. About twelve months after, the joint was found in the following condition:—The patella is drawn upwards, and rests on the lower third of the femur; the tibia is dislocated inwards; the two articular surfaces of this bone are very prominent in front, and the internal one projects considerably inwards, having slipped from the internal condyle of the femur. The joint was fixed and unyielding.

In both these cases there can be little doubt that some considerable alteration must have taken place in the joint-ends, in addition to the relaxation of the ligaments. It is quite possible that such accidents as those just described might, through neglect, produce most serious conditions of joint disease.

It is seldom that simple fracture of the patella gives rise to any fears as to the future of the knee-joint, yet that serious consequences may sometimes ensue is demonstrated by the case here recorded:

The patient was admitted into the Royal Free

Hospital, under the care of Mr. Weedon Cooke, on September 24th, 1859. Eighteen months previously he had fractured the patella transversely, and in less than a month left the hospital. On September 2nd he was seized with great pain in the knee during the night. On his admission it was found that suppuration had set in, and that the uniting ligament was destroyed. The two portions of patella were separated about four inches, and there were several openings into the joint. For many days he remained in a most critical condition, and pus formed in various parts of his body. After, however, great care, he recovered, and was discharged at the end of December with a stiff knee-joint.

Both Sir Astley Cooper and Sir Charles Bell relate cases of suppuration in the knee-joint after the cure of fractured patella. In Sir Astley's case the woman died, her condition not admitting of amputation. In Sir Charles Bell's the patient submitted to amputation, and I suppose recovered, as no mention is made to the contrary.*

Dislocation of the Tibia is one of the results of long-standing disease, where the ligaments are relaxed or destroyed, and the joint is extensively disorganized. As a general rule, the tibia is dislocated outwards and backwards, although Price quotes an extraordinary case, in which it was dislocated forwards at right angles to the femur. The biceps and popliteus muscles are the two muscles

* 'Lancet,' 1860, vol. ii, p. 209.

more immediately concerned, although, of course, all the hamstring tendons assist.

In a very interesting paper by Prof. W. Busch some important observations on dislocation and contraction of the knee-joint are recorded. In five sixths of all the cases examined the Professor found that after the leg had become flexed on the thigh to an angle of 45° , rotation of the leg outwards occurred. This he considers to be due, not to the traction of the biceps muscle, but the weight of the extremity, more especially the foot, and that it is afterwards fixed in the position by the contraction of the connective tissue. With regard to the luxation backwards, he asserts that this is due, not only to the contraction of the hamstring tendons, but to the actual compression and destruction of the posterior portion of the bones.*

A reference to the woodcut Fig. 4, p. 35, illustrates this rotation outwards of the tibia, although the foreshortening of the foot necessary for correct delineation prevents its being seen so prominently as it appeared in the original.

We have before noticed how the pain produced by the pressure of the exposed bone-surfaces together is relieved when dislocation takes place. The resulting distortion to the limb, even although all other disease be arrested, is one which calls for, in many cases, surgical assistance of a nature that will be afterwards discussed.

The lower end of the femur may sustain a fracture

* 'Arch. für klin. Chir.,' iv, 50. Sydenham 'Year-Book,' 1864.

running into the joint, and it is possible that this injury may give rise to inflammation and suppuration, with entire destruction of the joint, of such a character as to necessitate its removal. Price draws particular attention to an accident which seems to have escaped the attention of most surgeons, viz. separation of the lower epiphysis of the femur by direct violence. Mr. Canton twice excised the joint for this accident, once successfully, and once with subsequent amputation. These cases will be again referred to.

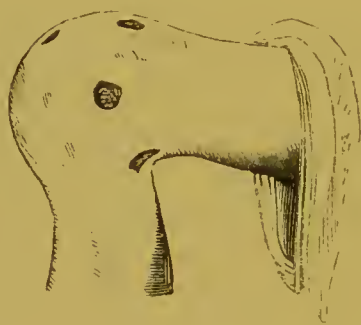
Anchylosis of the joint is a very frequent, and in many cases a very satisfactory, result of disease. It may be true or false. It is true, if there be osseous union between the opposed ends of the bone. The character of the bone thrown out varies with the constitutional condition of the patient. Thus, in weak strumous habits of body the bony material is scanty, and firm union does not take place.

False anchylosis is that which connects the bones together simply by soft membranous tissue. Unfortunately, the position in which the bones become anchylosed is frequently such as to render the limb useless to its owner. Sometimes anchylosis partaking of the true and false character is found; and Price states his opinion that the fibrous tissue between the bones acts as a sort of matrix, in which bone is deposited. The fact that in many cases, after excision, osseous union is delayed for a considerable period, and then takes the place of fibrous anchylosis, seems to bear out this opinion. The point is well

illustrated by a preparation in the Westminster Hospital, from a case of Mr. Heath's, the history of which is as follows :

The patient was a boy, æt. $11\frac{1}{2}$, who had scarlet fever, with swelling of the knee, six years before he came under Mr. Heath's care in 1858. Three years after this an abscess formed on the outer side of the left knee-joint, which was opened, and the boy was confined to bed for three months. A year before he came under Mr. Heath's care, another abscess burst on the inner side of the knee, and he was in a hospital for eight months. On admission under Mr. Heath, the knee was firmly fixed at a right angle, and was slightly swollen. There was an open sore on each side of the knee-joint, and one over the centre of it, which discharged freely (Fig. 5). The boy suffered pain at night,

FIG. 5.



but was otherwise in good health. Mr. Heath excised the knee in a block on June 29th, 1858, and the boy made a good recovery. The portion of bone removed included the articular surfaces of the femur and tibia, and the patella, which was firmly

fixed to the external condyle (Fig. 6). The bones showed erosion of the articular cartilages, where the bones were not already ankylosed, and also some

FIG. 6.



FIG. 7.



remnants of thickened synovial membrane (Fig. 7). On maceration for a short time, it appeared that the ankylosis between the patella and the outer condyle, and also on the inner side between the femur and tibia, was only fibrous; but, on the outer side, bone had been developed, as was seen on section. A second slice of the femur, which was removed in order to allow the bones to come readily together, was found to have included the whole of the epiphysis.*

Prof. Busch, in his paper on 'Contractions of the Knee' before quoted, states that false ankylosis is much more frequent than true, and he quotes Froriep, whom he considers to have proved that the contraction of the joint is due, not to the retraction of the muscles, but to the contraction of the fascia. This was proved in a marked way by an experiment on the limb of a girl who died after an operation for necrosis of the femur, and who had a leg flexed at a right angle. The extremity being removed at the

* 'Lancet,' vol. ii, p. 5, 1860.

hip-joint, was placed with its anterior surface downwards, and a weight of three pounds was then fastened to the foot. The origin of the flexor tendons was then divided, then the skin, after that the superficial fascia. It was not, however, until the deep tissues in contact with the posterior capsule were divided that any great alteration took place in the angle of flexion. Prof. Busch therefore concludes that in these cases little advantage accrues from the division of the tendons. The bearing of this upon the operation of excision of the knee-joint will be noticed hereafter.

The many diseases and injuries which affect the knee-joint have thus, in a very cursory manner, been passed in review. I have purposely, as each was noticed, refrained from considering the various modes of treatment which are employed, often successfully, to arrest the progress of disease, and to effect a cure with the smallest possible injury to the mechanism of the joint. The diseases have been traced from their commencement, through their various stages, to that complete destruction of the tissues of the joint which not only precludes the possibility of cure, but which places the patient's life in such imminent danger as to call for the entire and immediate removal of the whole diseased mass.

Having thus described the diseased conditions of the knee-joint, it remains for me to endeavour to show under what circumstances it is best to have recourse to amputation of the thigh or excision of the joint for their relief.

CHAPTER V.

OPERATIVE INTERFERENCE—EXCISION OF THE KNEE-JOINT.

*History of the Operation—Statistics—Price's, and
Hodges' Statistics compared—Great success in the
hands of certain Surgeons—Necessity for after
Amputation.*

THE progress of disease in the knee-joint must occasionally lead to the positive necessity for its removal. A rapid and acute affection may so depress the vital powers as to call for immediate interference on the part of the surgeon, in order that the patient's life may be saved; or the slower advance of some chronic malady may, little by little, reduce the patient to such straits as to demand the removal of the disease, lest continuous pain and copious purulent discharges should prove too much for his endurance. Or, again, long-continued disease, perhaps ill treated, or entirely neglected, may leave a knee-joint so deformed as to be, not only useless, but an absolute encumbrance to its owner. In each and all of these cases a very grave responsibility rests with the surgeon in deciding—first, as to the exact period at which operative measures should be had

recourse to ; and secondly, as to the nature of the operation which should be performed. With regard to the first of these difficulties, Bryant has well remarked that—

“Every surgeon must be able to recall cases where disorganization of a joint had taken place, whether from disease of the synovial membrane, cartilages, or bones, where the question of amputation or excision had been suggested ; and which the patient or his friends had positively refused, and where, to crown all, a recovery had taken place.”*

We must acknowledge the truth of this observation. Even the most acute insight into pathological conditions may yet fail to calculate correctly the power which any given individual possesses to resist disease or to repair its inroads. Nature, if she be fairly treated, will, after all, do the work of healing more completely than art can ever hope to do ; and it is a sad error to expose a patient to all the risks and distress of an operation, the result of which may, after all, be far inferior to what Nature herself might have effected. Yet, on the other hand, too long waiting on Nature’s offices betrays the timid surgeon. He lets his patient slip from his grasp. His timely aid might have saved a life, although at the sacrifice of a limb ; or he might have achieved a still greater triumph, and not only rescued his patient from impending death, but have left him with a limb, not indeed perfect as before, but still most useful for the purposes of locomotion. A day, a week, or

* ‘Diseases and Injuries of the Joints,’ chap. ix, p. 139.

a month of too long waiting, and his chance is gone.

Perhaps the second difficulty referred to is the greater one, viz. the nature of the operation which should be performed for the removal of the disease. To one operation, namely, that of Excision of the Knee, I now propose to refer.

The time was when no alternative existed for the surgeon, except the removal of an incurable knee-joint by amputation through the thigh. How many limbs have been thus sacrificed, and are, I fear, still being so, it is impossible to say. It is, however, satisfactory to find that the march of surgical science has provided another means of relief in excision of the diseased articular surfaces of the knee-joint; and the surgeon has now the opportunity of choosing whether he will remove the entire limb by amputation, or only the diseased joint, leaving a sound thigh and an useful leg and foot to his patient.

Great as is this addition to surgical science, I suppose there are few subjects which have caused more professional wrangling and discussion than this one of excision of the knee-joint. More than a hundred years have elapsed since Filkin of Northwich first performed the operation, and during the last fifteen it has been kept constantly under the notice of the profession by one of the most eminent Professors of surgery in England, and has been more or less practised in nearly all the hospitals of the United Kingdom. It has been written about, and lectured about. Statistics about it, more or less

reliable, have been collected from all parts of the world, and placed before the profession; and yet, in the face of all this, I fear it is but the simple truth to state that there is very little more unanimity on the subject of knee-joint excision now, than there was years ago, when first the dispute commenced. Nor am I inclined to think that this fact arises from any great fault on either side. Its first supporters may have been—I think they have been—too sanguine of success. They have promised a little more for the operation, than now that it has, as it were, come of age, it is able to perform. It has been undertaken in cases, no doubt, unfavorable to its perfect success; and operators have been too hasty in returning as perfect cases, those which time has proved to be anything but so. On the other hand, long before it had received a just trial, there was an evident tendency to “write it down.” Men who had never performed the operation, some who had never even seen it done, wrote about it and talked about it as if it were one of the most fearful innovations surgery had ever witnessed. I remember well an old and most experienced surgeon who was intensely prejudiced against the operation. He was present when I excised a joint; and, when the knee was laid open, I heard him remark that it was the most horrible operation he had ever seen. The case did exceedingly well, and I know that my friend has much modified his opinions as to this procedure.

It is really superfluous for me to repeat the oft-told history of this operation. Butcher, Holmes,

Hodges, Sir William Fergusson, and the late Mr. Price, have each and all of them laid before the profession most full and interesting details as to its rise and progress. The last-named surgeon laboriously collected a large number of cases of excision of the knee from the year 1761 to the end of the year 1860, and he divided this period into three, thus :

	Cases.	Cured.	Died.	Amputated.	Died.
From 1760 to 1830	... 17	... 7	... 10	... 0	... 0
„ 1830 to 1850	... 9	... 5	... 4	... 0	... 0
„ 1850 to 1860	... 238	... 150	... 52	... 36	... 7
	<u>264</u>	<u>162</u>	<u>66</u>	<u>36</u>	<u>7</u>

The first thing that strikes us in this table is the fact that, whereas in the first two periods, between 1760 and 1850, 14 deaths occurred in 26 cases, or 53·84 per cent.; in the last period, between 1850 and 1860, only 52 out of 238 died from the immediate effects of the operation, or 21·84 per cent. The decreasing ratio of deaths is further illustrated in a foot-note appended to Price's table by Mr. Henry Smith, in which he states that up to 1865 there had been 53 excisions of the knee-joint at King's College Hospital, with a mortality of 17, or 32·07 per cent. This is a very large per-centage, but it is explained that out of the first 24 cases, 12, or exactly 50 per cent., died, whereas in the last 29 cases only 5, or 17·24 per cent., succumbed to the immediate effects of the operation. In addition to these cases Mr. Henry Smith also appends 28 cases of excision since performed by Mr. Humphry and

Mr. Edwards, of which number 4 only died, or 14·28 per cent. The whole number thus recorded up to 1865 is 316, with 76 deaths, at the rate of 24·05 per cent. Out of this number 39 underwent subsequent amputation, 9 of that number sinking under the operation.

So much for the statistics of the operation up to the year 1865. Since that period I am not aware that any attempt has been made to collect together a large number of cases of excision of the knee. Dr. William MacCormac, one of the surgeons to the Belfast General Hospital, in a pamphlet comparing the two operations of excision of the knee and amputation of the thigh, has collected together 74 cases, not included in those above, which I have tabulated below :

Hospital.	No. of cases.			Recoveries.			Deaths.			Amputations.			Recoveries.			Deaths.		
St. George's...	...	17	...	12	...	5	...	0	...	0	...	0	...	0	...	0	...	0
Glasgow Infirmary	...	16	...	9	...	7	...	3	...	1	...	2	...	1	...	2	...	2
St. Thomas's	...	12	...	11	...	1	...	1	...	0	...	1	...	0	...	1	...	1
Chalmers'	...	12	...	6	...	6	...	0	...	0	...	0	...	0	...	0	...	0
Belfast General	...	6	...	1	...	5	...	1	...	1	...	0	...	1	...	0	...	0
Royal Infirmary,																		
Bristol	...	6	...	6	...	0	...	3	...	3	...	0	...	3	...	0	...	0
Guy's	...	3	...	3	...	0	...	3	...	2	...	1	...	2	...	1	...	1
London...	...	2	...	1	...	1	...	0	...	0	...	0	...	0	...	0	...	0
		<u>74</u>		<u>49</u>		<u>25</u>		<u>11</u>		<u>7</u>		<u>4</u>						

This table, although not containing many cases, presents some features of interest. First of all, it shows a very high rate of mortality, amounting to 33·78 per cent.; and although 49 cases recovered from the immediate effects of the operation, 11 of

them came to amputation, of which 4 died. It is curious also to note the differences which exist between the London hospitals, Guy's and the London contributing only 5 cases between them, with 4 recoveries and 3 subsequent amputations, whilst St. George's and St. Thomas's show 29 cases, with only 6 deaths and 1 subsequent amputation.

By way of comparison I append here a table containing some cases which, I believe, have not been before tabulated :

Hospital.	No. of cases.	Recoveries.	Deaths.	Amputations.	Recoveries.	Deaths.
Exeter	31	28	3	3	3	0
King's College,						
1865 and 1866 ...	25	17	8	0	0	0
St. Bartholomew's	14	12	2	0	0	0
Plymouth	8	6	2	1	1	0
Devonport	4	4	0	0	0	0
	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
	82	67	15	4	4	0

Here, then, we have a list of 82 cases, with 15 deaths, showing a mortality of only 18·29 per cent. Comparing these two tables, the one giving a mortality of 33·78 per cent., the other of 18·29, we cannot fail to remark how careful we should be in jumping at any conclusions drawn from statistical evidence. The difficulty of collecting together all the cases of excision throughout the country is so great that it never has yet been surmounted, and I believe, even if it could be, that little practical information would be obtained. Casting together all those that we now have before us, we may form the following table :

	No. of cases.	Recoveries.	Deaths.	Amputations.	Recoveries.	Deaths.
Recorded in Price's						
book up to 1865	316	240	76	39	30	9
Collected by Dr.						
MaeCormac	74	49	25	11	7	4
Tabulated by my-						
self	82	67	15	4	4	0
	<hr/> 472	<hr/> 356	<hr/> 116	<hr/> 54	<hr/> 41	<hr/> 13

Thus, we have 472 cases, with a mortality of 116, equal to 24·57 per cent. Of the 356 who recovered from the immediate effects of the operation, 54 underwent subsequent amputation (13 of them dying), leaving 302 with useful limbs.

It may be well here to compare these results with those of Dr. Hodges, of Boston. He has collected together 208 cases of excision of the knee. Of these, 106 recovered from the immediate effects of the operation and 60 died, giving a mortality of 28·84 per cent. In 42 cases, subsequent amputation was performed, death being recorded in 9 cases, whilst in 7 others the result is not stated. I need not point out how much more unfavorable an aspect these statistics give to the operation than the ones before recorded. I can only account for it in this way—that whereas Dr. Hodges' cases are taken not exclusively from British sources, the 472 cases I have recorded above, were all under the care of British surgeons, and I trust the difference may be thought to reflect credit upon our National surgery.*

* Heyfelder, of St. Petersburg, has collected 213 cases of excision of the knee-joint, with 64 deaths, being a mortality of 30·04 per cent. The results of excision of the knee in Paris during 1862 are as

Before leaving this portion of my subject I would remark upon the extraordinary success which has attended upon the performance of this operation in the hands of some surgeons. For instance, Mr. Humphry records the fact that he has excised the knee-joint in 39 cases, with only 2 deaths; 28 recovered with useful limbs, 9 underwent subsequent amputation, of whom 4 died.

Then, again, Mr. Henry Lee has, between June, 1860, and June, 1867, excised the knee-joint in 11 cases, and re-excised one of these, with only 1 death and no subsequent amputations.

The late Mr. Jones, of Jersey, excised the knee-joint in 19 cases, with only 1 death and 2 subsequent amputations; and Mr. Butcher records 6 cases without a single death or subsequent amputation.

Lastly, in Exeter, Plymouth, and Devonport together, the knee-joint has been excised in no less than 43 cases, with only 5 deaths and 4 subsequent amputations—a fact which, I may be permitted to say, speaks well for the surgery of the West.

One thing I think we may fairly deduce from our statistical inquiry, and that is that the results of the operation have steadily improved from the year 1760 up to the present time. Nor do I think that we have as yet reached the limit of perfection. I

follows:—La Pitié, female, æt. 25, white swelling, died; female, æt. 22, white swelling, died. Enfants Malades, male, 10½, white swelling, operation 24th April, died 20th May; male, æt. (?), operation 22nd May, died 1st November. Four cases, all of which died!

trust that I shall presently show that there are many points the strict observance of which, both in the selection of cases for operation, and in the operation itself and after-treatment, will secure for it a yet greater immunity from the heavy death-rate which at present attends upon it. Not only am I sure that the death-rate will be still further diminished, but I have great hopes, too, that the percentage of subsequent amputations, amounting to 11 per cent. of all the cases in the above table, will be reduced. It is astonishing what time and appropriate treatment will do for a limb, which seems at the moment, an incumbrance to its owner. Thus, many limbs may honestly be reported as "useful ones," after excision of the knee, which are even riddled with sinuses leading to diseased bone; and it must be the experience of any surgeon who has seen much of excision of the knee that, however troublesome sinuses and diseased bone may be to surgeon and to patient, both are very frequently rewarded for waiting, by the most perfect result which surgery can procure. On this point Sir William Fergusson makes the following apposite remarks in his lectures on 'The Progress of Anatomy and Surgery during the present Century:'

"A well-healed stump never in reality improves, unless, possibly, it gets more callous, whilst often it gets more tender and irritable; but the seeming perfect result of excision at the end of six or twelve months (just when stumps are generally at the best) is no criterion of true perfection. If the limb is

properly managed afterwards, it goes on improving for months—aye, for years. I can affirm, from ample experience in my own practice, that thigh, leg, and foot enlarge in bulk; and, in particular, that with this change the leg and foot improve in muscular energy.”*

But even if amputation becomes a necessity, as, of course, it sometimes must, it is really no argument against excision of the knee, that a certain number of cases wherein it has been performed, so terminate. Excision of the knee has been frequently justifiable, even although amputation of the thigh has afterwards become a dire necessity. Nay, I would even go further, and say that it is a positive duty which the surgeon owes to his patient to give him the chance of keeping a sound leg and foot, before having recourse to that last extremity—amputation of the limb. If the after-treatment of a case of excision of the knee be such as it should be, I contend that there are very few cases where, at the end of a considerable time, the patient is not as well able to undergo amputation of the thigh, if it be imperative, as he was before the operation of excision. Again, it is hardly fair to charge all the deaths following amputation after excision, upon the excision operation. Who is to say that death would not have resulted, if amputation had been resorted to as a primary procedure? In fact, the statistics of this operation

* ‘Lectures on the Progress of Anatomy and Surgery during the present Century,’ p. 132.

are at present most unreliable, owing, partly, I have no doubt, to the very incomplete manner in which our hospital records are preserved. In the case of simple amputation it is easy to record and collect the fact, either of death following the operation, or of recovery ; but in the case of excision, a lapse of time is required to test the true result of the operation, and during that time, the patient too often passes from the observation of the hospital authorities, and no more is heard of him. Feeling, therefore, as I have before stated, that a mere record of operations performed during any given period must, of necessity, be very incomplete, however extensive, I shall content myself with the foregoing observations, leaving to a future time, and to one more skilled in statistics, the further history of excision of the knee-joint.

CHAPTER VI.

MODES OF PERFORMING THE OPERATION OF EXCISION OF THE KNEE-JOINT; AND THE AFTER-TREATMENT.

*The First Incision—Section of the Bones—Kind of
Saw—Splints employed—Dr. Watson's Method—
After-treatment.*

BEFORE considering, in compliance with the more immediate requirements of this Essay, the diseased conditions in which the operation of excision of the knee-joint is advisable, it will be convenient to recount the method by which this operation is performed.

The patient being carried to the table, and placed fully under the influence of chloroform, an incision should be made across the joint, sufficiently large to expose the ends of the femur and tibia, with a strong straight bistoury, such as the one in the annexed figure (Fig. 8). The old **H**-incision is, I think, now nearly abandoned; for it was in reality far more extensive than there is any necessity for. The horse-shoe **U** incision, extending from the back part of one condyle to the back part of the other, across the joint, below the patella, dividing the skin and ligamentum patellæ at one sweep, is a very useful and now common mode of proceeding. Care should

be taken that this incision be commenced and terminated well *behind* the condyles of the femur, as it will then be found to afford, when the limb is placed in position, two dependent points for the escape of matter. Another method—and in some cases a preferable one, as producing a smaller wound

FIG. 8.



—is to carry the incision transversely across the joint. Mr. Henry Smith, in a note appended to Price's work, attributes the introduction of this plan to Sir W. Fergusson; but I think that Mr. Kempe, of Exeter, used it some years ago, and has continued to do so with the best results. The joint having been laid open in front, an assistant should gently flex the limb. The flexion should be very gentle, or mischief will be done to the bone. There is a preparation, which accompanied this essay, showing how the spine of the tibia was thus wrenched off;

and a record of a case where the surgeon, in forcibly flexing the limb, tore off the entire epiphysis of the tibia, is to be found in the 'Pathological Society's Trans.,' vol. xvii. The surgeon may now introduce the fingers of his left hand into the joint, and, by drawing up the condyles of the femur, put all the parts on the stretch, and thus facilitate their division; for it must be remembered that, in the flexed condition of the joint, the external and internal lateral ligaments are relaxed. The position of these ligaments must also not be forgotten; they are placed nearer to the hinder than to the fore part of the joint. The lateral ligaments being divided, and the crucial (if they remain), the integuments must now be carefully dissected up from the femur, and the portion of bone to be removed exposed. Great care should here be exercised to prevent the periosteum being stripped from the lower part of the femur—a fertile source of necrosis. Much of the after-success of the operation, depends upon the manner in which the section of the bones is accomplished. Owing to the width of the pelvis, the two femora are necessarily oblique in their axes, and the *internal* condyle is prolonged, as before noticed, in order to compensate for this, in order that the articular surfaces of the femur and tibia may be parallel. Hence it follows that, in cutting both the bones, it is of the greatest moment to maintain this parallelism by taking care to make the slices removed of the same thickness throughout; or if, by any chance, any difference should be made in one

section, that a compensatory allowance should be made in the other. It is also most important that the saw, when applied to the femur, should be held exactly perpendicular to the shaft of that bone. And a difficulty arises here in practice, owing to the tilting of the thigh, necessary, in order to separate it from the tibia. An unwary operator may be misled by the position of the thigh, and apply the saw perpendicularly to the patient's body, instead of to the bone about to be sawn; the same rule applying, though in a less degree, to the tibia. When the femur is cut thus incorrectly, the tibia, if brought into apposition with it, must necessarily bow outwards or inwards, as is frequently seen. The sawing of the femur, which should be commenced in front and carried backwards, will be much facilitated if the condyles are firmly held by an assistant with the lion forceps here figured (Fig. 9), whilst another

FIG. 9.



assistant firmly grasps the lower third of the femur with both hands. When the section of the bone is nearly completed, the lion forceps should be removed, and by tilting the back of the saw a little forwards, the operator can generally so far separate the portion of bone, as to enable it to be removed with the bistoury,

cutting from behind forwards. Thus, the danger of tearing the posterior capsule with the teeth of the saw, and wounding the popliteal vessels, is avoided. The section of the tibia can be made without the use of the lion forceps, but the same tilting of the saw, now a little upwards, will be found very much to facilitate the removal of the head of the bone. If the patella is fixed, as it frequently is, to the external condyle, it may sometimes be included in the section (see Fig. 6, p. 54); or it may be torn from its adhesions, if they are only fibrous. At any rate, the bone should in all cases be removed. Hodges states that the per-centage of deaths, following cases in which the patella was removed, was 21·31; whilst in cases where the patella was left, the percentage was 60·54—giving 39·23 in favour of removal of this bone. He also states that thirty days is added to the period of convalescence in cases where it is not removed. It is hardly necessary to remark, that the smallest possible portion of bone consistent with the entire removal of disease should be sawn off.

Circumstances sometimes call for a modification in the line of section through the bones, and the ingenuity of the surgeon is taxed to choose a plan, by which the entire disease may be removed, with as little sacrifice of bone as possible.

Thus, in a case of gunshot wound of the knee-joint, under the care of Mr. Crompton (see p. 44), that surgeon skilfully adapted the section of the bones to the requirements of the case. The principal

damage to the joint was found to be in the internal condyle. Instead, therefore, of making a transverse section of the femur above this injury, which would have involved great shortening of the limb, Mr. Crompton removed a thin section from the condyles of the femur, and another thin section from the head of the tibia. He then obliquely sawed off the internal condyle, thus removing the destroyed structure. The flat surfaces of the femur and tibia were then placed in apposition, and the case treated in the ordinary way.

In a case related by Dr. Watson,* I find the following modification :

“ With the view of removing as little of the femur as possible, he sawed off the condyles on a level with the condyloid pits by a transverse section, and then removed the upper and posterior portions of the articular surface by applying the saw at right angles to the original section, *i. e.* parallel to the long axis of the bone.”

Again, in order to counteract the tendency of the limb after excision to bow outwards, it has been proposed to make the section of the bones obliquely from within outwards, *i. e.* to cut the portion of bone removed from the femur, thicker at the outer side than the inner, so that when the cut surface of the femur is applied to that of the tibia the knee is thrown slightly inwards.

I refer to these deviations from the ordinary section of the bones to show that the surgeon need

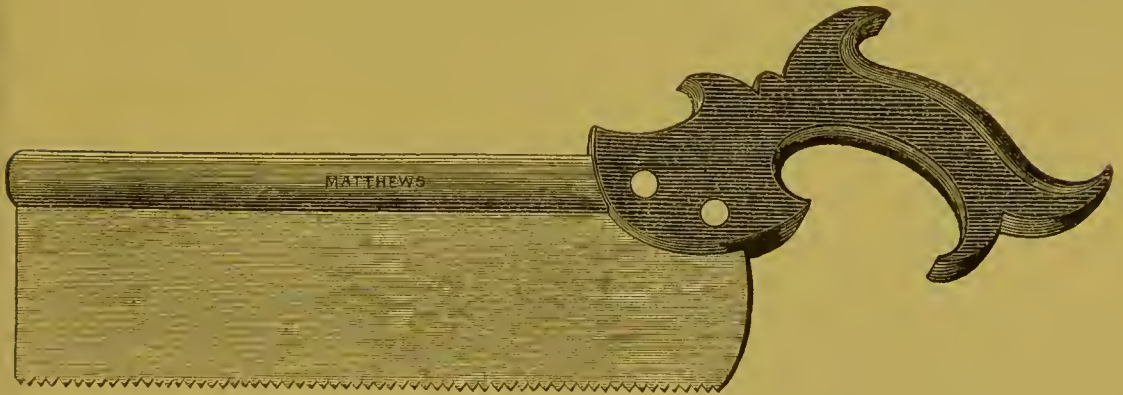
* ‘Excision of the Knee-Joint,’ p. 66.

not be bound to any hard and fast line of practice, but may modify his proceeding, to meet the various requirements of the cases that he operates upon.

Much difference of opinion exists as to the kind of saw that should be used. For my own part I know of none better than the common hand-saw, made sufficiently wide in the blade to cut through the broad surfaces of bone with which we have to deal.

The one here figured (Fig. 10) will be found to answer admirably. The blade is $7\frac{1}{2}$ inches long and $3\frac{1}{4}$ inches broad. The handle is large, and affords a

FIG. 10.



good firm grasp to the hand, whilst the blade is not too long to disturb the balance of the instrument. Another form of saw (Fig. 11) is very useful, but

FIG. 11.



not so good as the one just described. The blade

is $4\frac{1}{2}$ inches long, and $\frac{3}{4}$ inch broad, and is furnished with a shifting back, which is pushed up as the saw enters the bone. It also has a good firm handle. The first saw is, however, the better of the two, as it, amongst other advantages, enables the operator to tilt the section of bone, as described above. Both the saws are made by Matthews, of Portugal Street, Lincoln's Inn Fields.

Butcher's saw is used by many surgeons; but it is neither so firm, nor so entirely at the command of the operator, as the less complicated one above referred to. There is certainly this advantage attached to Mr. Butcher's instrument, viz. that the thin blade can be placed behind the bones and the section made from behind forwards. Attention, however, to the hints given above will prevent the necessity of using this precaution.

After the section of the bones has been completed, any circumscribed patches of disease may be removed with the gouge, and the rough edges pared off with the bone-forceps.

It is frequently the case, that the contraction of the hamstring tendons is so great that much difficulty is experienced in placing the femur and tibia in good apposition. Under these circumstances, it is advisable to divide these tendons through the wound, when, possibly, the difficulty will be overcome. I have before called attention to the fact that the simple division of tendons in contracted knee-joints, where the tibia is dislocated backwards, is sometimes of little use, as the contraction is found

to be more in the fascia and deep tissues in contact with the posterior capsule than in the tendons themselves. In cases, therefore, where, after having divided these tendons, there is still great difficulty in bringing the bones into apposition, it will be advisable to ascertain with the fingers whether any tense bands of fascia exist, and, if possible without danger to the vessels, divide them with a blunt-pointed tenotomy knife. If, however, it is still impossible to place the bones in good apposition, it will then be necessary to remove another slice from the femur. This proceeding should, however, be avoided, if possible, as it materially shortens the limb, and imparts an air of bungling to the operation. As much of the synovial membrane as possible should be removed, whether diseased or not, as its presence materially retards the future good progress of the case. Any suspicious-looking tissue should also be taken away; a pair of stout scissors, cutting on the flat, being very useful for this work.

It is very necessary to arrest all hæmorrhage before the limb is finally put up. I think we are too sparing in our ligatures in this operation. Every bleeding point of consequence, in the soft tissues, should be tied. I have frequently seen the most free hæmorrhage from the cut edges of the periosteum. A careful search for bleeding points should be here made. A little patience, and a stream of ice-water will generally arrest oozing from the surfaces of the bones. It is most distressing to the patient, and a fertile source of ill success, to have to take down

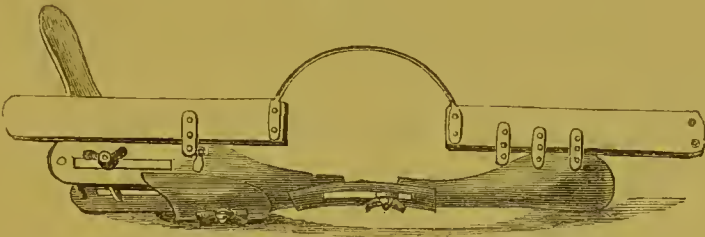
the limb, reopen the wound, and search for bleeding vessels. That free secondary hæmorrhage does sometimes supervene, we know from various recorded cases (see Appendix, Case 39); but it has never been my lot, in a pretty extensive personal experience of the treatment of excision cases, to meet with one that required the after-application of a ligature, the actual cautery, or a styptic of any kind. I am convinced that this danger is overrated, and that ordinary care at the time of the operation may prevent its occurrence.

All hæmorrhage having ceased, the cut ends of the bones should now be brought into apposition, great care being taken to prevent any of the soft parts slipping between them. Just at this stage of the proceeding the patient should be most fully under the influence of chloroform, in order that no spasm of the muscles may interfere with the complete adjustment of the limb. This is a point the neglect of which is a *very* frequent cause of damage to the limb. I have frequently seen severe spasm of the muscles of the thigh suddenly pull the femur up and render the adjustment of the limb most difficult. At this moment it is more than likely that mischief enough is done to secure a bad result. The cut surfaces of the tibia and femur are crushed and grated together, and the delicate cancelli broken up. The periosteum, too, is peeled back from the edges of the bones, and I have reason to believe that this is especially frequent at the posterior surface of the femur, where, in cases which turn out badly, necrosis

of the bone is so often found (see Appendix, Case 101).

The bones being adjusted, the limb should be immediately placed on the retaining apparatus, whatever that may be. I have no hesitation as to my own choice in the matter. There is no apparatus equal to the iron splint (Fig. 12), which is, I believe,

FIG. 12.



the only one ever used now by Sir W. Fergusson, and which is well known as Price's splint. My late friend himself thus described it :

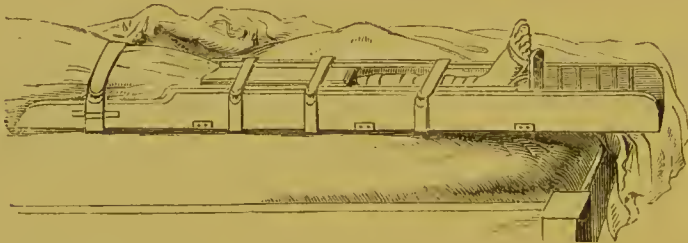
“The apparatus is an improvement on the ordinary McIntyre splint. It consists of two concave portions, the upper part corresponding to the lower half of the posterior surface of the thigh, and the other to the entire length of the leg. These two portions are connected by a narrow plate of the same substance as the splint, which is of enamelled tinned iron, and when in position corresponds to the popliteal space. The lower end is provided with a wooden foot-board, which can be regulated by means of a screw and slide to suit the length of the limb. The plate connecting the upper and lower portions, together with the part corresponding to the lower third of the leg, can likewise be regulated according to convenience.

“The outer side of the splint is provided with hooks, whereby a long side splint of wood, furnished with corresponding eyes, may be fastened. This splint ought to extend about two or three inches below the footboard, and to reach a little higher than the crest of the ilium. . . .

“The use of the side splint is the same as in fracture of the femur. By it, in conjunction with the perineal band, extension of the thigh is regulated, and the entire limb kept perfectly at rest.”* The side splint is, in very many cases, a superfluity; and I have frequently dispensed with its use throughout the entire run of the case.

The box advocated by Mr. Butcher (Fig. 13) is far

FIG. 13.



inferior, although that eminent surgeon has turned out of it many good cases. It is made of wood, and the sides, attached to the back by hinges, are intended to let down at the time of dressing. The inner side passes up to the ramus of the pubis, and the outer reaches to the axilla. The back and sides are padded with hair cushions, some being covered with oiled silk. A short broad splint is placed over the anterior surface of the thigh. My objections to it are—first,

* ‘Lancet,’ June 24th, 1857.

that it is of wood, and absorbs the discharges; secondly, that it is very cumbersome, and cannot be swung; and thirdly, that, in order to get at the sides of the wound, a portion if not the entire retentive apparatus must be undone, thus exposing the limb to the risk of jars and starts very detrimental to its well-being. Some surgeons use an ordinary McIntyre splint, which is in many ways most inconvenient.

Dr. Patrick Heron Watson, surgeon to the Royal Infirmary and Chalmers' Hospital, Edinburgh, has brought under the notice of the profession a plan of putting up excision cases which I have great pleasure in noticing here. The apparatus consists of two parts, "1. A suspension-rod made of iron, about the size No. 5 of trade wire gauge. 2. A modelled Gooch splint, long enough to extend from the tuberosity of the ischium to beyond the heel.

"*The suspension-rod* extends from the groin to the extremities of the toes, and is bent to the outline of the limb, departing from it only in the situation of the excision, where it forms a bow or arch. To the upper surface of the rod are attached one or more hooks by which the suspension is affected.

FIG. 14.



Suspension rod for front of limb — the arch corresponds to the site of excision, the suspension hook to the ankle-joint, upper end should terminate at fold of the groin.

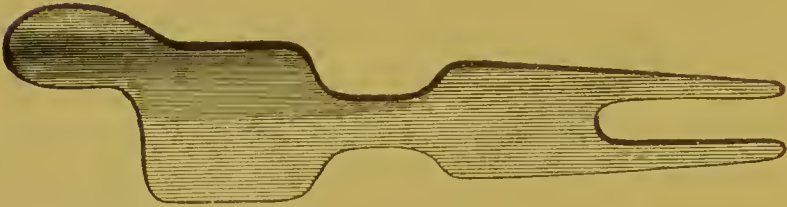
“ *The Gooch splint* should not be made too wide, and should certainly not surround the thigh and leg to more than two thirds of their circumference. It should be scooped away laterally, at a part corresponding to the site of the excision, and should have an aperture cut corresponding to the tendo-Achillis and heel.

FIG. 15.



Posterior “Gooch” splint of ordinary form.

FIG. 16.



Alternative form of “Gooch” splint, the rounded part above, adapted to the os innominatum, and secured by means of strips of adhesive plaster.

“ In application, the limb is first laid and carefully adjusted upon the posterior splint, which should preliminarily be padded with lint, and covered with gutta-percha tissue, or hot paraffin, in the situation which corresponds to the site of the operation. The iron rod is then placed in front, and folded lint laid between it and the limb at the groin (where the rod terminates above), at the upper part of the tibia, and at the bend of the ankle. These two parts of the apparatus are then retained in contact with the

limb by means of an *open-wove* roller bandage applied from the toes upwards, the site of the incision being alone left uncovered. The whole is then rendered immoveable by means either of plaster-of-Paris applied by the hand, of a consistence like thick cream, or of paraffin, which, having been rendered temporarily liquid by heat, is applied by a large painter's brush."* The admirable results depicted in Dr. Watson's book of this plan of treatment, are certainly strong recommendations in favour of its use. I have, however, seen a large number of equally good cases after the use of Price's splint, which I cannot help thinking is more simple in its application.

In Military surgery I can quite conceive that Dr. Watson's plan might be of great use, and when treating of excision of the knee after gun-shot injury I shall again refer to it.

Price's splint should be well padded, great care being taken that the pad in the thigh and leg part should overlap the edge of the splint, to prevent galling at any part. That portion of it immediately under the knee should be covered with Mackintosh sheeting, and should be made rather full, so as to project into the popliteal space. Small supplemental pads, also covered with Mackintosh, should be at hand; one especially being often required to go under the head of the tibia, to prevent its tendency to fall backwards behind the femur. Webbing straps and buckles should also be at hand. Not only must the splint

* Dr. P. H. Watson, 'Excision of the Knee-joint,' p. 18.

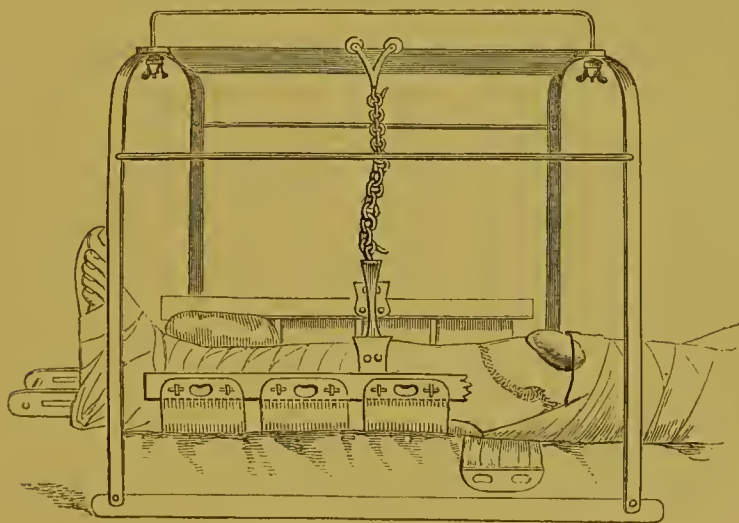
be well prepared, but the limb itself should be carefully protected for its long sojourn there. All the prominent points of bone, especially the malleoli, the heel, and the tendo-Achillis, should be covered with amadou spread with soap-plaster. The foot should be carefully bandaged from the toes up to just below the tubercle of the tibia. A bandage should also be firmly applied to the thigh from above downwards. I believe this latter precaution to be a most useful one; for not only does it to a very great extent control spasmodic action of the femoral muscles, but it also prevents matter from burrowing back amongst them—a complication most tedious to deal with, and often fatal to the good result of the operation. All these preparations should be made in the ward before the operation. A little care and supplemental bandaging will prevent the permanent bandages from being soiled during the operation.

The limb is now to be placed in the splint; and, the bones being in perfect apposition, it should be fixed there by four strips of adhesive plaster, three inches broad, and long enough to go twice round the limb and splint—one a little above the malleoli, another just below the head of the tibia, another just above the condyles of the femur, and the last at the upper part of the thigh. As a final step, the wound should be brought together by two or three sutures, the sides being left open for the free exit of all discharges. There is a double object in leaving the wound open to the last moment. First, we are able to secure more perfect adaptation of the ends

of the bones; and, secondly, to stop any further bleeding points which may present themselves in the soft tissues. Finally, a bandage is applied, further confining the limb to the splint, but leaving the wound exposed, which should only be covered by a square piece of wet lint.

The patient should now be removed to bed, placed on a water-pillow, and the leg swung in a "Salter's swing" (Fig. 17).

FIG. 17.



I may here remark that Salter's swing has been much improved by Mr. Greenway, of Plymouth. His "leg suspender," which is fully described in the '*Lancet*' of February 24th, 1866, consists of a base which is fixed to the side of the bed, two upright pillars, and an overhanging top to which is attached the travelling gear, affording longitudinal, transverse, rotatory and swinging movements. This suspender has many advantages, and in the after-treatment of

excisions it is very useful, because it is unilateral, and enables the limb to be dressed without removing the cradle.

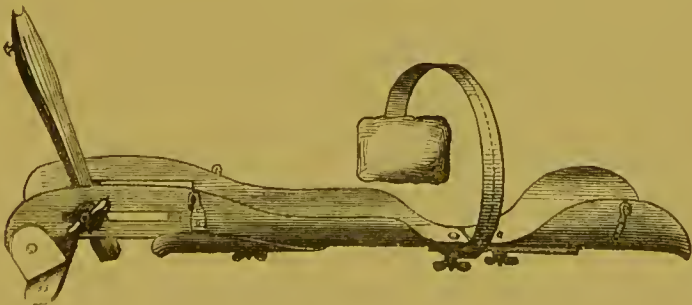
I consider the water-pillow of great consequence. By it the pelvis is, as it were, swung, and the patient can move about with the greatest freedom, without a single jar being communicated to the limb. If the patient be, as is sometimes the case in females, of an excitable, nervous temperament, the administration of a subcutaneous injection of one third of a grain of morphia, before the effects of chloroform have passed off, has a most quieting effect, and will often procure long and refreshing sleep.

After-Treatment.—In a case managed as above described, the after-treatment is of the simplest kind. Throughout, one great object must be kept steadily in view; viz., *the perfect immobility of the limb*. In a well-managed case of excision, there is not the slightest possible necessity to touch any of the retentive appliances for at least a month or six weeks after the operation; and then, in all probability, the limb may be once for all removed from the splint, and placed in some other support. Tow carefully tucked in under the edge of the bandages nearest the wound, and changed once or twice a day, effectually prevents the matter from running up by the sides of the splint; or the edges of the bandages above and below the wound may be thickly coated with paraffin, which would glue them to the surrounding skin, and form an impermeable barrier to

all fluids running under them. If the discharge is very profuse, a drainage-tube inserted on each side, at the lower point of the wound, will conduct off a great deal of pus, and prevent its soiling the splint and bandages. When suppuration is fairly set in, it is often useful to syringe out the wound with a solution of Condyl's fluid, or with the "red lotion;" but, of course, any local application will be made in accordance with the particular condition of the case. I have never seen it used, but I can quite conceive that the application of a bag of ice to the parts immediately after the operation, and the retaining it continuously for some days, would prevent the approach of much evil, and be a source of great comfort to the patient.

The position of the limb should be a continual source of care. The judicious application of a pad, strap, and buckle, may rectify any commencing displacement. The bowing outwards of the joint is one of the most troublesome distortions we have to contend with. To prevent this, I have had a "truss-pad" made, which, taking its fixed point from a bar

FIG. 18.



attached to the inner side of the splint, passes over

the joint, and presses the limb inwards and a little downwards. A very good drawing of this apparatus is appended (Fig. 18).

The steps of this important operation, and the after-treatment of the case have been thus minutely described, because I am convinced from my own observation, and from recorded accounts, that frequently very many of the precautions which have been recounted are entirely neglected, and cases which might have turned out successfully have been lost, or suffered amputation. Not long ago, I saw a case where, on account of not very excessive secondary oozing, the limb was taken down on the evening of the operation, the sutures removed, and the actual cautery freely applied. Again, about the third or fourth day, when suppuration has freely commenced, I have known the limb removed from the splint (the wooden trough of Butcher) to cleanse it. Price, in his analysis of cases, gives many examples where limbs were undoubtedly sacrificed to bad after-treatment. For instance, in one case, the cause for amputation was stated to be "exhaustion, and the pain from dislocation which had occurred."* Then again, the patella was allowed to slip between the ends of the bones, and "the patient died from *exhaustion* and *irritation* after some months." In another case, "considerable difficulty was experienced in keeping the bones in apposition: irritation of their extremities, and the consequent lighting up of unhealthy suppuration, induced necrosis of the lower

* Price, 'On the Knee-Joint,' p. 77.

end of the femur; so that amputation was needed after some weeks.”* In another case, amputation was resorted to “on account of non-union, necrosis, and *displacement of the cut ends of the bones.*” Three cases—“a clumsy flat leather splint with the first case, the McIntyre in the others, with too frequent shiftings, being used to support and steady the limb”—very soon came to amputation. In two cases, “mechanical irritation of the cut ends of the bones induced such an amount of inflammatory mischief in both of the bones and periosteum, that death was thereby the consequence.” In another case, “on the third day the dressings had been changed, and a pillow and sand-bags substituted for the splint.” In another, “the patient was shifted every few days;” in another, “the tibia and femur were allowed to shift their positions;” and in all these amputation was had recourse to. Thus twelve cases are recounted where the want of success following this operation may be fairly attributed to insufficient care in the after-treatment.

I need hardly point out that, until the treatment of these cases is better understood, statistical records of ill success must be taken for what they are worth. Sir W. Fergusson† has very aptly compared this operation to a compound fracture of the femur or upper end of the tibia. Would any surgeon in his senses, take down a compound fracture every three or four days, to see how it was going on, or to clean

* Price, ‘On the Knee-Joint,’ p. 85.

† ‘Lectures on the Progress of Anatomy and Surgery,’ p. 122.

the splint? And if, as is more than likely, such a case came to amputation, or the patient died of "irritation," would this be used as an argument against the attempt to save the limb, and in favour of primary amputation? I think it would rather be set down as an indication that the surgeon who thus acted did not know his business, and had sacrificed his patient's limb, or life. There are, of course, many more difficulties to contend with in treating a case of excision of the knee, than in a compound fracture of the lower extremity; but the principle should be the same in both cases—perfect and prolonged immobility secured by the use of appropriate retentive apparatus. When surgeons thoroughly recognise this principle of action, we shall begin to find out that the results of the operation of excision of the knee-joint are not quite so bad as some would have us think they ever must be.

CHAPTER VII.

DISEASED CONDITIONS IN WHICH THE OPERATION OF EXCISION OF THE KNEE-JOINT IS ADMISSIBLE.

*Disease of Synovial Membrane—Acute Suppuration—
Disease of Articular Cartilage—Influence of Rest
—Disease of Bones—Abscess in the Bones—Diffuse
Deposit.*

WE now proceed to consider those conditions of disease in the knee-joint which are favourable for the operation of excision of the joint.

It has been already stated, that much of the previous ill-success of the operation of excision of the knee, depends upon an injudicious selection of cases for its performance. The highest authority on this subject has made the following statement:—"I may myself have been too zealous, and resorted to the operation where I should have selected amputation."* Nor can we doubt that this has been very generally the case, and that, in the first flush of enthusiasm, we have been led to excise joints in cases where the amputating-knife would have been better employed. Are we now in a position to avoid this error, at any rate to a great extent? I think I may safely say that we are. Fifteen years' experience

* Sir W. Fergusson, 'On the Progress of Anatomy and Surgery,' p. 119.

of the operation, and the vast amount of detail which has been laid before us lately, especially by Hodges, Holmes, Price, and the lectures above referred to, must give us opportunities of judging rightly, which the pioneers of knee-joint excision had not; and, if we use our opportunities well, greater perfection in the results of this operation must be attained.

In deciding as to whether a diseased joint should undergo excision, the three following points deserve the most prominent attention :

1. The extent and character of the disease.
2. The constitutional condition of the patient.
3. The patient's age.

I believe the importance of these considerations to be in the order in which they have been stated; and first, let us consider—what is the character and extent of the disease which warrants the removal of the joint by excision, with a fair and reasonable hope of retaining to the patient an useful limb?

In treating of this question it is hardly necessary to consider those conditions of disease confined simply to the soft tissues. No operative measures should ever be undertaken whilst disease is confined, for instance, to the synovial membrane. In cases, even, of gelatiniform degeneration, the surgeon would be most culpable if he resorted to extreme measures at so early a stage of the disease as that in which the synovial membrane was alone affected. Indeed, not only is it incurring a wanton risk in the performance of what may be a needless operation,

but there seems to be a peculiar fatality attending upon excision for disease of the synovial membrane alone. I have extracted from Price's list no less than twenty-one unsuccessful cases in which the operation was undertaken for the removal of diseased synovial membrane only. And Mr. Cadge, of Norwich, writes, "It will be generally found useless to remove the ends of the bones, when the synovial membrane is the primary and chief seat of disease." The reason of this is, I think, obvious. In the first place, we lay open a joint the main tissues of which are unaffected by disease; and the shock to the general system is in proportion to the integrity of the joint. In the second place, we expose healthy bone-tissue, with the cancelli open and not condensed by disease, and the consequence is that the risk of purulent absorption or infiltration is all the greater. I cannot agree with Price's opinion on this point; viz. that "the proceeding is not only justifiable, but advisable." "If the diseased action is confined to the synovial membrane, the bony structures are completely healthy," writes Price;* and in that sentence he plainly shows that the operation should not be undertaken; for, with perfectly healthy bony structures, and a disease confined to the synovial membrane, I can see no reason whatever why a cure by much less heroic means may not be procured.

In cases of acute suppuration most surgeons now agree in condemning recourse being had to excision. As a general rule, no doubt, excision should not be

* 'On the Knee-Joint,' p. 130.

performed in these cases; but, as an exception, I would refer to a case which was under the care of Mr. Kempe, of Exeter, the history of which is given in the appendix (Appendix, Case 59). This was a case of acute synovitis, with abscess in the popliteal region. The constitutional condition of the patient was in every way against the performance of excision of the joint, and amputation was urged upon him. He, however, declined that proceeding; and eventually the knee was excised with the admirable result stated in the appendix. I have been enabled to trace out this case, and the following woodcut from a photograph shows his present condition (Fig. 19.)

FIG. 19.



Another case recorded by Dr. Watson is also worthy of note.

A woman, æt. 30, was admitted into the hospital, who for some time past had suffered severely from pain in the knee.

For a few days previously the joint had become greatly swollen, and the pain was frightful. On June 30th, 1866, the joint was excised. A quantity of turbid serum, containing flocculi of purulent lymph, escaped when the joint was opened. On September the 1st the limb was taken from the splint. The wound was healed, and the bones consolidated, the shortening amounting to little over an inch.*

It must, however, be admitted that these cases are exceptional. They may tempt us, under very favourable circumstances, to pursue a similar course, but the advice given on this point by Mr. Holmes is worthy of note, and I quote it here: "Excision usually much increases the amount of suppuration, and generally excites a very great degree of surgical fever. Hence I should fear that it would very generally hasten the fatal event instead of averting it; so that I have always preferred to amputate: though I do not deny that excision might succeed in occasional cases of acute abscess of joints—and I have myself seen at least one such case—and even sometimes in cases of prostration after the opening of such abscess."†

The extension of the disease to the articular

* Watson, 'Excision of the Knee-Joint,' p. 42.

† Holmes, 'Surgical Treatment of Children's Diseases,' p. 418.

cartilage renders the question of operative interference, in my opinion, more easy of decision. There can be no doubt that the bones very soon sympathise with the articular cartilages, and that, even although disease be not actually commenced in them, yet continuous hyperæmia at length may produce considerable condensation of the osseous structure, thereby rendering it more favourable for section.

It has been already shown that the so-called ulceration of cartilages, exposes the osseous structure of the joint, and produces a train of symptoms of a most distressing character. Here we are satisfied that the integrity of the joint is destroyed. We may labour to obtain ankylosis in good position, and very frequently, no doubt, our labours are crowned with success. Still, our most complete success cannot restore a perfect knee; and the remembrance of this fact will lead us to undertake the operation of excision with less compunction. These cases of disease of the articular cartilages are very frequent; and they come to us, too often, in so advanced a stage, that little short of removal of the disease is of much avail. A knee-joint flexed at right angles, the tibia drawn back behind the femur, exquisitely painful to the touch, causing agony at every movement, and starting so painfully as to arouse the poor patient hour after hour during the night from the soundest repose, is unfortunately familiar to most surgeons. When the disease has reached this stage, frequently, all attempts at pallia-

tive treatment signally fail. Even placing the limb on a splint does but increase the patient's sufferings ; for the hamstring tendons are so tense that the stretching to which they are subjected causes intense anguish.

It is not asserted that at this stage of the disease favourable ankylosis may not sometimes be obtained; but I have frequently seen the attempt fail after many months of suffering, which has reduced the patient to a condition very unfavourable to operative measures of any kind. Besides, even when a supposed cure has been effected, a fall or a blow will frequently again set up inflammation in the joint, and the unfortunate patient will have once more to drag through months, if not years, of suffering. This recurrence of the disease in a joint apparently cured is illustrated by a case in the Appendix (Case 33), and will be referred to again further on. The length of time expended in procuring a cure may be illustrated by reference to a case, given by Mr. Hilton, in his 'Lectures on Rest and Pain,' of "disease of knee-joint treated by mechanical rest, cured by firm bony consolidation." The treatment commenced in March, 1852. The limb being placed in "a deep trough" of wood, steady pressure upon the joint by soap-plaster was kept up for several months"—we are not told how many. A thick leather splint was then applied, which "He wore nearly *five years*; the latter part of the time at night only. For *sixteen months* he was not allowed to make the slightest attempt to bear any weight upon

his leg. He was carried about in the arms of his mother, or placed in a little carriage, and dragged out daily, weather permitting. Then he began to get about cautiously on crutches. His general health was very bad; but the knee was diminishing in size.

After going to Wales to the seaside, abscesses formed about the joint, bursting into the popliteal space; and in the month of June, 1861, he is pronounced cured—that is to say, he has an anchylosed limb, not by any means at a good angle, after steady continuous treatment for the space of nearly ten years! The accompanying illustration is copied from Mr. Hilton's book, and shows the position of the limb at the conclusion of the case. (Fig. 20.)

FIG. 20.



I have quoted this case at length to show how so celebrated a surgeon as Mr. Hilton can—if I may be permitted to say—carry in some cases to excess, what as a general rule must be considered good and careful surgery. From henceforth the grand argument against excision of the knee-joint, that recovery from the operation is so long in taking place, may be abolished. There is no case on record that I know of that has taken ten years.

The opinion of another surgeon of experience regarding prolonged attempts to cure disease of the knee-joint may well be introduced here. Mr. Solly, in a clinical lecture ‘On Diseases of the Joints,’ delivered at St. Thomas’s Hospital, thus speaks :

“If the operation (excision of the knee-joint) succeeds—that is, if your patient neither dies from the effect of the operation, which I must allow is very rarely the case, or the limb is not obliged to be removed ultimately, an event not so uncommon as we could wish, then the ankylosis is more certain than that which is obtained by medical as distinguished from operative surgery. I must confess that I have been disappointed in some of my cases of natural as distinguished from artificial ankylosis by their return to the hospital, after I had hoped a complete cure had been effected.”*

I believe that these acutely painful cases of articular disease are eminently marked out for treatment by excision of the joint. As an example of this class of disease I would refer to the following case, fuller

* ‘Lancet,’ 1861, vol. i, p. 51.

particulars of which are given in the Appendix (Case 89).

The patient was a young girl, æt. 16, who was admitted under my care into the Royal Albert Hospital, in February, 1864. The condition of the joint on admission is correctly portrayed in the adjoining woodcut (Fig. 21), the knee-joint being

FIG. 21.



firmly fixed in the position seen. For five years she had suffered from repeated attacks of inflammation in the joint. As an out-patient she had been treated with tonics, and a gutta-percha splint had been adjusted to the limb. Upon her admission the limb was placed on a McIntyre splint and swung.

It was also blistered, and various other applications were made. Extension in any shape or form she could not endure, and night after night her pain was so intense that no sedative procured her rest. On May 28th, I excised the joint, finding the bones more extensively involved than I had expected. On November 19th, she was made an out-patient, the limb being firmly ankylosed and in perfect position.

The woodcut (Fig. 22) shows her condition at the time of her discharge.

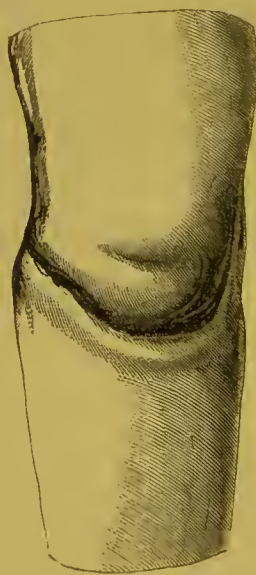
FIG. 22.



The case in many points illustrates the propriety of excision. It came under my notice at an advanced stage, when considerable contraction of the knee had taken place. "The influence of rest" was

fully tested for many months, but the disease steadily progressed, and the excessive pain and broken rest told much on my patient's constitution. After the operation, she experienced little or no pain, except at an after stage arising from exceptional circumstances, viz., the unfortunate galling by the splint in the upper part of the thigh, which produced a large diffuse abscess. The great point to which I would direct attention is this: that whereas before the operation no sedative procured her rest at night, no sooner was the diseased articulation removed, than she slept night after night, with comparative ease and comfort. A singular, and I believe unprecedented, accident befel her. Soon after she left the hospital cured, with perfect bony ankylosis, she fell over some stone steps, and fractured the femur two inches above the excised knee; the osseous union there remaining intact. The cast of the limb

FIG. 23.



sent in with the Essay was taken in December, 1865, and the annexed woodcut is copied from it (Fig. 23). I venture to assert that, although my patient was not much more than ten months, instead of years, under treatment, the result will bear comparison with that above quoted.

A very similar case of disease is recorded by Mr. Solly in the clinical lecture before referred to, illustrating also the immediate relief from prolonged suffering afforded by the operation of excision of the joint. The boy was much emaciated and suffered from loss of appetite and night sweats. The cartilages were found extensively diseased, with slight secondary disease of the bones.

Mr. Solly remarks—"It was delightful to see this poor boy's countenance on the morning after the operation. He said he was quite free from pain, which the poor child had not been for months. Since this the boy's health has gradually and steadily improved."*

Another case (see Appendix, Case 33), under the care of Mr. Bowman at King's College Hospital, illustrates the fact I have noticed above, that, even after an apparent cure of these cases, an accident will again set up all the old mischief, and necessitate a further course of treatment. Here, in 1859, the patient was discharged from hospital with a limb nearly straight, and he was able to walk pretty well by the help of crutches. In 1861, he fell down and knocked the knee; the result of which accident is

* 'Lancet,' 1861, vol. i, p. 53.

fully detailed in the case. There is a fact also mentioned which deserves notice; viz., that only an inch and a half of the femur was removed, and that upon section this was found to include the entire epiphysis and a portion of the shaft of the bone. Half an inch only of the tibia was removed. It shows how very sparing we should be in removing bone when the articular surface is only involved in disease. I append two illustrations of this case. Fig. 24, before the operation; fig. 25, the present condition. A cast of the limb, which I have fortunately been able to obtain, accompanied the Essay.

FIG. 24.



FIG. 25.



On October 16th, 1865, I obtained the following report of this case. The boy is now aged sixteen. Height, four feet nine inches. Heel of left foot, four

inches from the ground when he stands upright with his toes touching the ground. Right side from anterior superior spinous process to inner malleolus, thirty-two inches; left side, ditto, in straight line, twenty-four inches and three-quarters, but following the outward curve of the limb twenty-six inches.

There was a preparation sent in with this Essay of the articular ends of the femur and tibia, removed by Mr. Whipple, at the South Devon Hospital in December last. It illustrates the gradual thinning of the articular cartilage and the encroachment of "ulceration" from the edges. The spinous process of the tibia was firmly fixed by fibrous ankylosis to the femur, and was broken off from the tibia in flexing the limb during the operation. The case was stated to be rheumatic arthritis. It did exceedingly well.

These cases of advanced disease of the cartilage are eminently adapted for excision of the joint, especially if the operation be performed before the constitutional symptoms have become seriously aggravated. The bones are not often much involved, and it is sufficient to remove merely the extreme articular surfaces; so that there is not much shortening; and, in young subjects, the saving a portion of the epiphysis provides for the future growth of the limb.

In the Appendix, several cases of strumous disease of the knee-joint will be found; in most of which the disease, I believe, was principally connected with the cartilages, although the bones were secondarily affected.

We must next refer to those cases where the bones are primarily diseased, or where they have become extensively involved as a secondary result. In considering the question of excision as applied to cases of diseased cartilage, we have of necessity also noticed that extension of the disease which involves simply the articular surfaces of the bones. The application, however, of excision to cases where the bones are primarily involved, or where there exists a considerable amount of disease in their structure, is a question upon which there is a very wide divergence of opinion.

Much of the success of excision of the knee, when undertaken in cases where the bones are involved, depends upon the ability of the surgeon to determine as to the condition of the cut surfaces of the bones after the articular surfaces have been removed. If the diseased conditions are restricted to the immediate neighbourhood of the joint, or if, although extending somewhat more deeply into the spongy portion of the bone, the disease is yet circumscribed; then, the constitution admitting, there is no more reason why excision of the joint should not be performed, than there was in those cases of disease of cartilage which we have just been considering.

Allusion has already been made to the condensation of the bone which takes place in the earlier stages of inflammation, and which was well illustrated by a preparation sent in with the Essay, where, in fact, simple hyperæmia is just merging into inflammation. On sawing through a bone thus affected,

we find the cavities of the cancelli diminished, and their walls thickened, and the whole surface presents a reddish pink hue from the colour of the serum exuded. This condition of the bones, whilst it demonstrates the fact that serious mischief has not extended deeply, is also a warrant to the surgeon to proceed with the excision, and gives the greatest hope of a successful result. It is not often the good fortune of the surgeon to meet with a case thus uncomplicated. It is more usual to find this condition alternating, as it were, with other and less favourable states of bone. Thus, we may find spots of ulceration, named by Barwell "*caries circumscripta*," or pieces of necrosed bone, "*caries necrotica*," surrounded by indurated tissue. The surgeon will have to decide in such a case, whether the amount of indurated tissue surrounding these diseased conditions, is sufficient to warrant perseverance in the excision. The softened and necrosed portions, if not in excess, may easily be removed with the gouge, and thus a surface obtained well calculated to ensure after success. It is a question to be decided at the time, to how great an extent gouging should be carried. I have certainly seen admirable results after the very free use of the gouge; but it is a fact that abscess of the bone occasionally follows, causing severe suffering to the patient, and ultimate destruction of the parts involved.

I cannot go the entire length that the late Mr. Price has, in stating that, if

"One of the condyles and a mere shell of the tibia

remain after the articular surface and synovial membrane have been removed, sufficient consolidation will admit the recovery of a useful though considerably modified limb.”*

He quotes a case of his own, which turned out well; but certainly, in the generality of cases, such an advanced state of disease would be better treated by amputation, than to run the risk of entire failure in the results of the excision, or at best recovery with a “considerably modified limb.”

To show, however, how much *may* be done even with the most extensive disease in the neighbouring bones, I quote the following case which came under my notice during the time I was house-surgeon to King’s College Hospital:

A patient, æt. 13, was admitted with extensive disease of the lower part of the femur and knee-joint; the latter, although not ankylosed, was permanently bent at an angle of forty-five degrees, but the patella was firmly ankylosed to the condyles to the femur. The condition of the knee, and thigh above it, appeared to be in such a state, that amputation of the limb was really entertained as offering the only means of getting rid of the accumulation of disease. Sir W. Fergusson thought, however, he would give the lad a chance, and removed the whole of the necrosed bone from the interior of the new shaft, and from the external condyle also. This was followed by the best results, the discharge diminished, and the wounds promised

* Price, ‘On the Knee-joint,’ p. 136.

to heal. So much was this the case, that he was looked upon as in a favourable condition for excision, in order to straighten the limb, and to give the patient a useful leg. This was accordingly done three weeks after the first operation, when a wedge-shaped piece of the femur, including the anchylosed patella, was removed, and a slice of the tibia. The joint was comparatively healthy; an opening was present, as large as a goose-quill, in one of the condyles of the femur, produced by the extension of the necrosis, very near its surface.

The case progressed admirably, and the boy made a good recovery with a very useful limb.

Circumscribed collections of matter are sometimes found in the spongy textures of the bones, which, if of moderate size, need not impede the operation. A case of excision of the knee performed by Mr. Wood at King's College Hospital (Appendix, Case 23) is an example of primary disease of the bones, and abscess in the head of the tibia, for which the operation was performed. The right knee was swollen, semi-flexed, and very painful. The end of the femur and the whole epiphysis of the tibia were removed. In the head of the tibia was a circumscribed abscess. The synovial membrane and articular cartilages were healthy.

In a case of a lad, *æt.* 14, under Mr. Paget's care at St. Bartholomew's Hospital, there was also found on section of the tibia, an abscess which had opened into the joint. No doubt here the disease commenced in the cancellated structure of the head of

the tibia, an abscess formed, and bursting into the joint destroyed it. The case made a good recovery with a limb two inches and a half shorter than the other.*

Another case before referred to under the care of Mr. Smith (Appendix, Case 34) again illustrates both the primary disease of the bones, and also the presence of an abscess in their cancellated structure. In this case, however, the joint itself was involved, being firmly ankylosed. Excision was performed, but the case terminated fatally from pyæmia on the twelfth day.†

Another diseased deposit in the ends of the bones we have already discussed (p. 35)—viz. “the tuberculous matter” insisted on by Price. I have stated elsewhere my reasons for not thinking this deposit to be analogous to tubercle of the lung. Its actual nature has, however, little bearing on the question of excision. The diffuse variety of this disease is entirely unfitted for the operation of excision. The earthy constituents of the bone are very much diminished, and there is little or no chance of repair after the operation. In addition to this, as Barwell justly remarks—

“A diffuse inflammation, wherever it be situated, and whatever be its products, always marks so low a constitutional state, that we should give the system as little reparative labour as possible.‡

* ‘Lancet,’ 1862, vol. ii, p. 383.

† See fig. 65, p. 407, and fig. 67, p. 422, in Holmes’ ‘Surgical Treatment of Children’s Diseases.’

‡ Barwell, ‘On Diseases of the Joints,’ p. 423.

In the circumscribed variety there is no reason why the same treatment should not be applied as in cases of circumscribed caries or necrosis. In fact, I am inclined to think that better results may sometimes be expected; for it is often found that the surrounding bone is more healthy and capable of repair than when a carious or necrotic condition is present.

This opinion is confirmed by a statement of Mr. Henry Lee, who attributed the success of the operation in his hands to the fact that he has had a large proportion of cases in which the ends of the bones had been consolidated by previous inflammation, caused either by the presence of a piece of dead bone, or by an abscess.*

If, upon making the section of the bone, large diffused extravasations of blood be present, or if it present a dirty yellow appearance from diffuse suppuration, the operation of excision is not admissible.

* 'Brit. Med. Journ.,' vol. ii, p. 600, 1868.

CHAPTER VIII.

EXCISION OF THE JOINT FOR TRAUMATIC INJURY AND DEFORMITY.

Immediate Excision after Injury—Secondary Excision—Excision for separation of Lower Epiphyses of Femur—Excision for Gunshot Wounds in Civil and Military Surgery—Excision for Deformity.

THE question of excising a knee-joint which has been laid open and otherwise extensively injured by an accident, is one which deserves more attention from writers on the subject of excision of the knee than has hitherto been given to it. This neglect, perhaps, arises from the fact, that our opportunities in civil practice of performing the operation for injury to the joint are few and far between.

In civil practice Mr. Bryant has shown that the mortality following amputation of the thigh for traumatic injury is 60 per cent. for primary, and 75 per cent. for secondary amputations. It is hardly possible to imagine that any proceeding can show much worse results than these; and I cannot help thinking that there are very many cases of extensive wounds of the knee-joint hitherto treated by amputation, which might have had a better chance of re-

covery if the articulation had been removed by excision. I do not wish at the present moment to enter into any comparison between the two operations of excision and amputation; but I simply now make this statement, in which I believe I am fully justified, that the shock after excision is less than that after amputation. Now, severe injury to a large joint like the knee, is a source of great shock to the patient; and it appears to me that, as a primary proceeding, the operation which adds the least to the existing shock is the one that gives the best chance of immediate rally to the patient. I can see no difference between the after-conditions of an excision thus performed, and one undertaken for a diseased articulation, except that in the former case we have in all probability a robust constitution to back up the operation, whilst in the latter the ravages of long-standing disease detract very much from the reparative powers of the patient. I believe that there are many cases of severe lacerated wounds of the joint happening to young robust subjects, now treated by immediate amputation, which would do very well, and have a better chance of recovery, if excision were practised. I append the history of a case in which Mr. Kempe, of Exeter, acted on this principle, and had the extreme satisfaction of saving both the limb and the life of his patient :

“June 10th, 1862.—John Fewings, Exwick, æt. 13, was admitted under the care of Mr. Kempe, with a lacerated wound of the right knee freely communicating with the joint, the result of an accident.

Excision of the joint was performed about one hour after the receipt of the injury. Great constitutional disturbance and some delirium followed the operation, which were subdued by opium, &c. A large abscess formed on the right hip, apparently arising from some extravasated blood which took place at the time of the accident.

“He was made an out-patient in September, with a very firm union of the bones, but with one or two small sinuses.

“Mr. Kempe saw this lad about twelve months after his discharge loading a railway van, apparently with as little inconvenience as if he had suffered no loss of the joint.”

It is worthy of note here that the operation was performed almost immediately after the receipt of the injury, and although “great constitutional disturbance and some delirium” followed, this might be, perhaps, fairly put down, as much to the account of the accident itself, as to the operation for excision. The formation of an abscess about the right hip is, too, not to be overlooked, as it directs our attention to the necessity for careful examination of the entire limb in such cases before deciding on excision rather than amputation. If injury of much magnitude exists in other parts of the limb, such as severe contusions and effusions of blood, the operation of excision had better not be performed. If the soft parts are extensively lacerated, or if fractures in the bones extend far from the joint, there can be no doubt about the impropriety of attempting excision

of the joint. As a secondary proceeding another case is recorded by Dr. Watson, of Edinburgh.

On January 24th, 1866, he was called to see a woman, *æt.* 32, who in a fit of temporary insanity had thrown herself from a window twenty-five feet from the ground. In addition to other injuries, she had a compound comminuted fracture of the right patella, the fragments being driven into the cancellated substance of the articulating end of the femur. She was much collapsed, but on January 25th reaction having taken place, Dr. Watson excised the articular extremity of the femur, leaving the head of the tibia untouched.

Up to February 10th everything went on well, when the patient had a rigor.

She became gradually comatose, and died on the 26th.

At the post-mortem, numerous metastatic abscesses were found throughout the lungs, and recent pleuritic adhesions. The excision parts looked very healthy. The unfortunate termination of this case by pyæmia can hardly be put down to the selected operation. It was, perhaps, not a favorable case, as we are told that the patient had sustained several other injuries. At the time of her accident she was, too, in a state of temporary insanity, and although she had recovered from that the next day, yet the post-mortem revealed disease of the arachnoid.*

It is also a question how far the "partial" excision in this case affected the result.

* 'Excision of the Knee Joint,' Dr. P. H. Watson, p. 59.

Excision of the knee-joint after traumatic injury has been performed with success as a secondary proceeding ; and bearing in mind the fact above stated, that the mortality following secondary amputation of the thigh in civil practice has been put down at 75 per cent., we may well endeavour to supplant so fatal an operation, by one less destructive to human life.

In May, 1861, the late Mr. Price excised the knee-joint of a child, *æt.* 6. Two months previously the joint had been extensively laid open by a cart-wheel. Considerable shock was sustained. Extensive suppuration followed, large abscesses running up the thigh. The case is reported to have done well.* Here it appears a very praiseworthy attempt was made to save the limb without any operative interference, and that failing, excision of the joint, in preference to amputation of the thigh, was had recourse to. This case fairly illustrates the remarks made in Chapter IV upon the necessity of delaying, if possible, immediate amputation of the thigh for traumatic injury to the knee-joint.

Another secondary excision of the knee after traumatic injury was performed by Sir W. Fergusson at King's College Hospital on May 10th, 1862. The patient was a female, and suffered from ankylosis of the right knee and dislocation, the result of acute inflammation set up by a needle which was driven into the joint by a fall sixteen months previously. The needle remained in the joint for six weeks. The patient made an excellent recovery, and was

* 'Lancet,' 1861, vol. i, p. 588.

discharged 105 days after the operation with a perfectly straight limb about two inches shorter than the left.

At p. 42 I referred to a similar accident under the care of Mr. Erichsen. There is no account given in the present case of the immediate results of the accident, but they must have been severe to have caused the painful distortion for which the operation was performed. In Mr. Erichsen's case the patient fortunately recovered with a joint ankylosed in good position. In the one under consideration, a person in poor circumstances, the after-treatment must have been bad, or the joint would not have become fixed in a flexed position, and necessitated the performance of a severe operation to put the limb straight, and make it useful to its owner.

In some statistics of the Birmingham General Hospital I see also recorded a case of Mr. Crompton's where excision was successfully performed for "compound fracture of condyle of femur, with wound into knee-joint;"* whether this was a primary or secondary operation is not recorded.

In addition to these, two cases of excision were performed by Mr. Canton at the Charing Cross Hospital, for a condition which was the immediate result of an accident; viz., the forcible separation of the lower epiphysis from the shaft of the femur.

The following is Mr. Canton's history of the first case :

"CASE 1.—William Jarvis, æt. 15, was admitted

* 'Medical Times and Gazette,' vol. ii, 1864, p. 67.

into the Charing Cross Hospital under my care October 21st, 1859. At the time of the accident he had sustained, he was playing with another lad, and, with the view of eluding him, was about to run under the body of a horse that stood close by. The animal, however, seeing him approach, suddenly rose on his fore-feet, knocked him down, and then kicked him violently just above the left knee, with one of his hind legs. On attempting to rise, the boy found himself unable to stand; and, to escape further injury, he was forced to roll quickly along the ground out of the horse's reach.

On admission, the affected limb was found to be shorter than its fellow; foot quite everted; leg slightly flexed; patella directed outwards; great and general swelling around the knee, and with such distortion of the parts, as to give the impression of the tibia being dislocated backwards, and somewhat outwards. The inner femoral condyle appeared to project unduly, and the skin covering it was tense and abraded. On the outer side, and above the patella, a forward elevation of bone could be felt. By extension and counter-extension, the due length of the limb was restored, the patella resumed its natural position, and the projections referred to became obliterated. The usual appliances maintained adjustment.

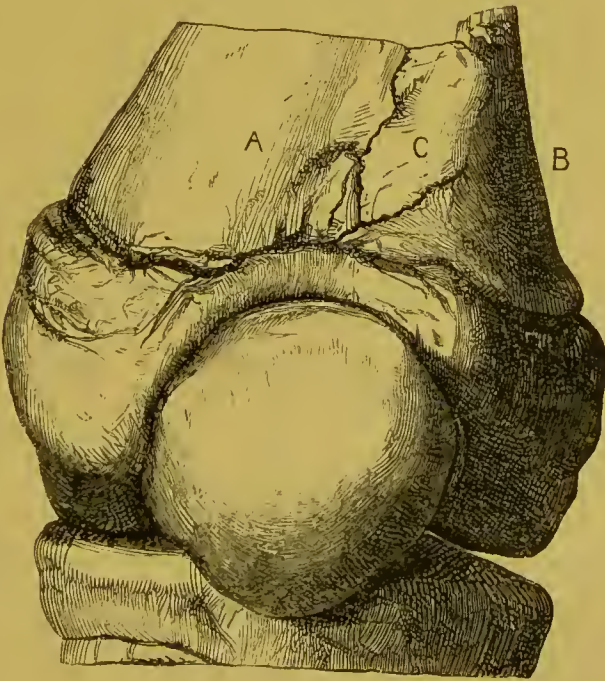
No untoward symptom occurred until the end of October, when the incessant restlessness of the patient, from his intolerance of the necessary restraint, gave rise to violent inflammation of the

joint. On the inner side of the knee the soft parts began to slough, and in two days afterwards, the subjacent bone projected through the mortifying tissues. The part protruded was the lower end of the shaft of the femur. The high constitutional disturbance which was set up forbade further efforts to save the limb entire, and I excised the knee-joint by the usual form of operation on the 3rd of November.

No peculiarity marked the further progress of the case; and after the lapse of several months the patient walked out of the hospital cured.

The parts removed (Fig. 26) show a separation of the shaft of the femur from its lower epiphysis to have occurred in about three fourths of its circum-

FIG. 26.



ference (A), while the remaining fourth is still firmly fixed in normal position (B). An oblique fracture extends through the whole thickness of the shaft, and commencing at its outer side, reaches down to the epiphysis, where it runs into the line of separation between these two parts. Between the attached (B) and separated (A) portions, a fragment (c) is seen, which in the engraving is shown restored to its place; but which had been driven backwards at the time of the accident between B and A completely into the popliteal space, whence I removed it during the operation.

Twelve months after the excision of the joint, I again saw and examined the patient.

From a photograph then taken of him, the annexed outline has been accurately made (Fig. 27).

The tibia and femur were firmly incorporated with one another; and the patient walked twelve miles without fatigue."

In the second case the patient was exceedingly restless, and after the first excision had been performed, an inch of the femur protruded and had to be removed with the saw. Fibrous ankylosis resulted; but, as the limb proved useless to the patient, Mr. Canton amputated the thigh, and the patient did well.*

Excision of the knee after injuries by gunshot wounds, is a question of great interest, especially to Military surgeons. I have referred at some length to this class of injury in a foregoing chapter (Chap.

* 'Dublin Quarterly Journal of Medical Science,' February, 1861.

FIG. 27.



IV, p. 43). Whether it is advisable to treat such accidents by excising the damaged joint is a question deserving much consideration. It is not my duty, in this work, to refer to any plans of treatment other than excision of the knee, or amputation of the thigh. Nevertheless it is expedient to notice how frequently knee-joints, severely injured by bullets, or shell, do well, and, in some cases, regain, to a great extent, their mobility. Of such sort are those quoted in Chapter IV, where the extent of

injury sustained, renders it quite wonderful that the limbs could have been retained.

Returning to the question of excision, I must again call attention to the two cases of primary excision for gunshot wounds, performed the one by Mr. Hutchinson, at the London Hospital, and the other by Mr. Crompton, at the General Hospital, Birmingham.

The first case unfortunately was lost by tetanus, but as far as the operation of excision went, was going on very favourably. The second case recovered with a most useful limb. M. Spillmann has published in the '*Archives Générales de Médecine*,' the history of thirteen cases of excision of the knee in civil practice for gunshot injury with only three deaths, including the case of Mr. Hutchinson.

Dr. William MacCormack justly remarks upon this, that: "Although the cases prove few in number, the results are striking, and should certainly encourage us to attempt the preservation of limbs by resection of the knee, which by gunshot or other injuries of the articulation, would otherwise have been certainly condemned to amputation."* I am sure many surgeons will endorse this opinion, and we may trust that in the future, limbs will be spared which have been hitherto sacrificed from want of knowledge how applicable excision of the knee is to these cases.†

* '*Observations on Amputation of the Thigh*,' pamphlet, p. 12.

† Since writing the above I have found the record of another successful case of immediate excision after gunshot wound. The operation was performed by Dr. Thompson, surgeon to the Tyrone County

If, however, the result of civil practice is thus cheering, that of Military surgery is most gloomy. The same authority, M. Spillmann, has collected twenty-one cases where excision had been performed for injury to the knee-joint; out of these the enormous number of nineteen died. This is, indeed, a result which is almost sufficient to deter Military surgeons from ever again having recourse to the operation of excision of the knee on the field of battle.

The surgery of the American war gives some data of interest on this subject, with, however, the same gloomy results recorded. In Circular No. 6, issued from the Surgeon-General's department, a table is given in which are recorded 770 terminated cases of gunshot wounds of the knee-joint. The rate of mortality following amputation was found to be 73·43 per cent., whilst excision of the joint was performed in eleven cases, with only two recoveries, or with a mortality of 90· per cent. The treatment by free incisions into the joint seems to have been attended with little better success.

The returns of excisions during the Crimean War, from April 1st, 1865, to the end of the campaign, show only one case of excision of the knee, and that a fatal one. This operation was performed by Mr. Lakin on a private of the 77th Regiment, who, whilst retreating from the Redan, received a musket-ball in his left popliteal space. No fracture or injury to the joint could be detected, but as there was no

Infirmaries, Omagh, and the history of the case is fully recorded in the 'Dublin Quarterly Journal,' August, 1868, p. 27.

aperture of exit it was considered certain that the ball remained either in the neighbourhood of, or else in, the joint itself. Twelve days after the wound had been inflicted, the joint became swollen and painful, and on the twenty-third day, October 1st, it was resolved to make an exploratory incision, and, if necessary, to excise the joint. This was accordingly done. The cartilages covering the bones were found partially detached. There was no fracture of the bones, except a small piece chipped off the inner and posterior edge of the head of the tibia. Excision of the joint was then proceeded with, and on making the section of the femur, the ball was found to have lodged in the inner condyle. An inch and three quarters of the femur was removed, and a thin slice from the head of the tibia. The patella was also dissected out. Up to the 25th the patient went on very well, the limb had acquired some firmness, and the wound in front was healed. From that time diarrhœa set in, and the patient rapidly ran down and died on the 28th.

“I ascertained,” adds Mr. Lakin, “after his death, that on the 26th and 27th he had eaten some apples which he had bought, and that the vomiting and diarrhœa came on after that.”*

It is much to be regretted that a case which at first promised so well, should have come to this untoward end. Had it been otherwise it is possible that the success of this single case might have encouraged other surgeons to adopt a similar plan

* ‘Notes on Surgery of the Crimean War,’ p. 354. Macleod.

of treatment, and its correctness or otherwise would then have been fairly tested. The fact, however, that during the whole campaign the operation was only once performed, is sufficient to show that there has been hitherto considerable reluctance on the part of Military surgeons in our own Army to adopt this line of practice. I have little doubt that this reluctance arises from the difficulties which are to be met with in the after-treatment of these cases. I cannot refrain from quoting at length here the remarks of Dr. Watson upon his plan of after-treatment as applicable to Military surgery :

“I am confident from my experience of the employment of this plan of after-treatment, that it is admirably adapted to the exigencies of a campaign, and that it is likely to prove advantageous to the military surgeon, by enabling him, on active service, to undertake the excision of the knee-joint in the midst of all the uncertainties of a regimental camp hospital, or even when on the line of march. In other words, the Military surgeon may with it, safely excise the joint, where he knows that he cannot have the advantages of a fixed and permanent hospital for the after-treatment of his patient. I must confess that I have had no practical experience of this procedure under such circumstances, but, having had ample experience of the exigencies and difficulties which do arise, and which must be met in the treatment of surgical cases during the campaign; and furthermore, having made experience of what is to be obtained from this plan of after-treatment,

I can say, with every confidence, that were I myself engaged in the surgical treatment of patients during another campaign, I should never hesitate to employ excision in preference to amputation, in cases of injury of the knee which have hitherto been supposed to require amputation, or from which, at all events, excision has been withheld, not because the operation was deemed improper or insufficient, but because the means necessary for after-treatment were not to be obtained."

I trust it may be long before our gallant Army is again called upon to take the field against an enemy. When, however, that time does arrive, it will be no small gain to the science of surgery and to humanity, if our Military surgeons can see their way to the more extensive adoption of knee-joint excision. Few, we know, are more ready to receive improvements, or more able to carry them out, than the present highly-educated men who will have charge of our future armies, and although, as I said before, I hope the means of proof may be far distant, yet we may boldly prophesy better results than those given us by M. Spillmann and the Surgeon-General of the American Army.

Deformity of the limb resulting from old disease in the joint is the last condition requiring excision which we have to consider. This proceeding is, I know, open to very grave objections, and although many surgeons have performed the operation, and restored to their patients useful limbs, there is to my mind this grave drawback to its general adoption; viz.,

that the life of the patient is endangered, without the actual necessity having arisen for its being so. It is every one's experience with what facility the unfortunate possessors of very deformed knee-joints, move about with the help of some simple apparatus. Is it right, under these circumstances, to subject the patient to the extreme danger of a capital operation? And, even supposing the patient recovers with a fair limb, is he so very much better off than he was before? To both questions, I am bound to give a negative answer. Of course, I am writing here of cases in which Nature has effected a perfect, although a very rude cure of the original disease; not of such cases as the one referred to in a previous chapter, where a slight accident will again set up active disease in a joint apparently quite cured.

With regard to the after-condition of the limb, it must be remembered, that old and long-standing disease has rendered the leg and foot stunted and ill-developed. And, supposing the most favourable result, there must of necessity be considerable shortening of the limb, requiring very likely an apparatus even more cumbersome than the one before in use. Hodges gives an account of nineteen cases of excision for deformity, eight of which terminated fatally, from circumstances directly connected with the operation, and one came to amputation, osseous union being long delayed.

At the earnest desire of patients, or their friends, I think the surgeon may be justified in undertaking this operation; but I cannot think that he is justi-

fied either in suggesting the proceeding or pressing it on the patient. Rather than remove a limb by amputation I would have recourse to excision as a less formidable proceeding, and should advise the latter operation if pressed by the patient to do something to remove an intolerable encumbrance. Thus, I excised a knee-joint for deformity, partly at the earnest desire of the boy's mother, and partly (I was more influenced by this latter consideration) because I found that, although the disease was quiescent, every now and again the boy fell on his knee and set up active inflammation in the joint. The case made a satisfactory recovery (Appendix, Case 90), but there was considerable shortening of the limb, carious bone in the head of the tibia, and only fibrous ankylosis for some time, bony deposit having since taken place. I once removed some carious bone from the head of the tibia, after which the condition of the limb much improved, and I have great hopes that in time he will have an useful limb.

The adjoining woodcut (Fig. 28) correctly represents this boy's condition before the operation. He was unable to get about without a crutch, with which he was, however, very nimble.

The woodcut (Fig. 29) shows his present condition; and he is now able to run with the aid of a stick very rapidly. The limb is two inches and three quarters shorter than the other.

Very similar to this is a case recorded in the 'Lancet'* which was operated on by Mr. Holmes

* 'Lancet,' vol. i. 1862. p. 406.

FIG. 28.



FIG. 29.



at the Hospital for Sick Children in August, 1862. The patient was a boy, *æt.* 13. The knee was dislocated from old disease, flexed at an acute angle, with the foot far from the ground. His mother said "that he was always tumbling about, and hurting his knee, which was a source of constant pain and annoyance to him." The operation of excision was performed on the 9th of August, and illustrates the extreme difficulty which is sometimes met with, in these cases of deformity, in getting the bones into proper position. The joint was opened, and the firm ankylosis between the tibia and femur broken down. Then the end of the femur was removed;

but extreme difficulty was found in making the section of the tibia, as it was so firmly locked in the popliteal space. Successive slices having been removed from the femur, the bones were, at length, got into position. The boy did very well, and was discharged on the 9th of November, with a straight leg and solid union, the limb being shortened two inches and a half.

The difficulty here experienced in getting the bones into perfect apposition suggests the propriety of adopting in these cases a different method of section of the bones. It will be observed that in this case the joint was opened and the ankylosis between the femur and tibia broken down before the section of the bones was made. Now, it is the practice of some surgeons, and I think a preferable one, to excise the entire joint in a block, without breaking down the adhesions between the bones. An illustration of this method was given in Chapter IV, p. 54, in a case of Mr. Heath's.

In his account of the operation, given in the 'Lancet,'* he writes—"Having made an H incision, I attempted to turn up the patella with the flap, but found that bone firmly fixed to the outer condyle, and the femur also ankylosed to the tibia. I therefore removed the whole joint in a wedge, carrying the saw immediately behind the patella, and through the upper part of the tibia." Fig. 5, p. 54, shows very well the lines of incision through

* 'Lancet,' 1860, vol. ii, p. 5.

the femur and tibia, and the resulting block which was excised.

In the 'British Medical Journal,'* Mr. Crosse, of Norwich, also followed the same plan in two cases under his care in the Norfolk and Norwich Hospital. In the first case, a girl, *æt.* 8, an attempt was made on two occasions, in 1858 and 1859, to forcibly straighten the limb. These attempts failed, and in 1862 she was readmitted into the hospital with the leg bent at right angles to the thigh, and the joint quite immovable. It is curious to note that in 1861, after the second attempt at forcible extension, the case was reported on thus:—"I see this patient from time to time; she is able to get her heel down upon the ground, and to walk about, although very lame. The knee-joint remains stiff." Yet although so favourable a condition was then reported, in less than eighteen months she again came into hospital in the condition above described. Mr. Crosse describes the operation for excision, which was performed in June, 1861, thus:—"I resected the joint, making a single straight incision across the front of it, just below the patella; and when I had sufficiently cleared away the soft structures from the front of the femur and the head of the tibia, I sawed out a wedge-shaped portion of bone, cutting first through the femur and then through the tibia."

The case did very well, and in the summer of 1863 Mr. Crosse reports that the girl's condition

* 'Brit. Med. Jour.,' 1863, vol. ii, p. 211.

had much improved, and the union of the bones was firm and solid.

In the second case, which proved to be one of partial fibrous ankylosis, the same plan of operation was adopted, and the entire joint removed in a block. The patient made an admirable recovery, and was able to bear some weight on the limb two months after the operation. It appears to me that this plan of excising the entire block, in cases of firm ankylosis, between the femur and tibia, very much facilitates the operation. The surgeon is better able to judge of the exact amount of bone to be removed in order to get the parts in apposition, and the very great difficulty experienced in making the section of the tibia after its connections with the femur have been broken down, is avoided.

There is one reason which may be urged against this plan, and that is that the danger to the vessels in thus making the section is increased. If any operator should feel this a valid objection to the operation, the difficulty may be removed by using Butcher's saw, passing the blade behind the bones on a director and cutting from behind forwards. Care must, however, be taken to set the blade at such an angle as to ensure the bones being divided at a proper angle.

Of a somewhat different nature to the foregoing cases is one on which, in 1862, Sir William Ferguson performed the operation of excision, in King's College Hospital.*

* 'Med. Times and Gaz.,' 1862, vol. ii, p. 276.

The patient was a man, æt. 25. He was strong, muscular, and in perfect health. He had, however, a left knee-joint bent at right angles, but in which there was no active disease. The history of the case seems to point to strumous disease of the joint at the early age of two years. The limb was stunted in growth, measuring from the great trochanter to the malleolus two inches less than its fellow. We may presume that the patient felt this limb an encumbrance, and desired to get rid of it. Rather than amputate, Sir William Fergusson preferred to excise the joint, which he did, in a block, as above described, on June 14th, 1862. Much trouble was at first experienced in the after-treatment, owing to the extraordinary spasmodic condition of the muscles. The patient, however, made a good recovery, and left the hospital in August with firm bony union, and able to bear weight on the limb.

Another case in which this operation was performed at the same hospital on an adult, by Mr. Henry Smith, is of interest.

The patient had been a private in the Fusilier Guards, and was shot through the knee at Inkermann. The bullet was removed from the popliteal space at Scutari. On his way home inflammation set in, and he was detained at Gibraltar for some time. The knee became ankylosed in a very bad position, but the patient got into the Commissionaires, and was able to perform light duty. The limb was, however, a constant source of trouble to him, getting inflamed and painful on the slightest provocation.

On September 6th, 1863, Mr. Henry Smith excised the joint in a block, and found that perfect bony ankylosis had taken place between the femur and tibia. The case went on very well, and he was discharged on December 9th, cured. One year after the operation he thus writes of himself:—"My health is good, and my limb is all that could be desired. I have walked many a long journey with it, with nothing but a walking-stick as an assistant. I can walk three miles an hour with perfect ease. I wear one inch of cork on the inner side of my boot, which makes up all the deficiency in length. My knee is quite tight and firm at the joint."*

The foregoing cases may, I think, be looked on as types of those conditions which warrant the surgeon in performing the operation of excision of the knee-joint for deformity.

I may conclude this portion of my subject by the following quotation:—"In many instances of so-called cure of disease of the knee," writes Sir William Fergusson, "the limb is left shortened, bent, flaccid, useless, and the body is borne on a crutch. In all such cases, when the usual modern means of extension have proved of no avail, surgery has heretofore held out no alternative between a crutch and amputation.

"When patients are discontented—where amputation has often been requested, and frequently performed, to give riddance from a useless member—I can testify by experience to the excellent results of

* 'Med. Times and Gaz.,' 1863, vol. ii, p. 377.

excision. By removal of the stiffened or anchylosed articular end of the bones the limb has been stretched; a treatment like that for compound fracture has been adopted; union, new anchylosis, has taken place, with the limb in a proper line; and a comparatively useful member has been the result.”*

* ‘Lectures on Progress of Anatomy and Surgery,’ p. 145.

CHAPTER IX.

THE CONSTITUTIONAL CONDITIONS AND THE AGE ADMITTING EXCISION OF THE KNEE. RE-EXCISION.

Tubercle in the Lung—Rheumatic and Kidney Disease—Age of the Patient—Want of Growth of the Limb after Excision—After-nutrition—Age after which Excision should not be done—Re-excision—After-treatment of the Excised Limb.

THE condition of the patient after excision of the knee is such that great demands are made upon his reparative powers, and upon his ability to resist the severe suppuration that frequently follows. It really seems so reasonable, that it should be a *sine quâ non* for the patient to be free from any other exhaustive visceral disease, that one is surprised to find surgeons advocating the practice of excision when visceral disease is present. There can be no doubt that, if we could agree upon this one point, to give up the satisfaction of excising a knee-joint when the joint-disease is complicated with other serious constitutional lesions, we should materially reduce the mortality following the operation. It should be a golden rule—one of the few without exceptions—that tubercle of the lung contra-indicates excision of

the knee. The extraordinary case quoted by Price, in his appendix, is just a solitary one, where the immediate success of the operation may, perhaps, lead us to hope for similar results in phthisical patients; but, on reading over the case, I am inclined to think that it was a condition of very incipient tubercle in the lung. By good luck, and good management too, the case made a rapid recovery; but, if any mischance had happened, I can have no doubt that the lung-mischief would have been increased, and the patient would have fallen a victim (as another case of his is reported to have done) to acute phthisis.

In cases of rheumatic disease of the joint, great care should be taken to ascertain the condition of the heart; and it should also be borne in mind that an atheromatous condition of the arteries sometimes exists, which, if present, would be a grave objection to excision of the joint. The urine should be tested, and if a deranged condition of the kidneys is discovered, it will materially interfere with the after progress of the case.

“Is it not a remarkable fact,” writes Mr. Savory, “that damaged kidneys have, as the rule, much more influence upon the result of an operation or injury, than a damaged heart, although the action of the kidneys is not so immediately necessary to life as that of the heart.”*

There can be no doubt that, as a rule, recovery from excision is a longer process than recovery

* ‘Lancet,’ 1867, vol. i, p. 141.

from amputation of the thigh. Of course, there are rapid cases of complete recovery from excision; as, for instance, one which I well remember, under the care of Sir W. Fergusson at King's College Hospital, where the man walked into the theatre six weeks after the operation; but this is quite exceptional. When, then, the constitution is enfeebled by other disease than that in the joint, I think that the procedure which holds out the best chance of rapid recovery should be adopted. If, for instance, a strumous joint has reached that stage of disease in which it is a constant source of trouble and annoyance, and if it seems to increase, as no doubt it frequently does, the irritation of tubercle in the lung, it should be removed; but rather by amputation of the limb than by excision of the joint.

The age of the patient is a point of great importance. Hodges states that excision of the knee has been performed as early as three years, and as late as sixty-eight. The former case recovered, but with what condition of after-limb is not stated; the latter died, as one would naturally have expected. The average age of the patients who died after the operation, according to Hodges' curiously minute calculation, was $25\frac{2}{23}$ years, and of those who recovered $19\frac{29}{32}$.* There can be no doubt that the more fully developed the limb is, the more favourable is it for excision of the knee. The removal of the epiphyses, and the consequent loss of growth in the limb, have been fully discussed elsewhere. If in

* Hodges 'On Excision of Joints.' p. 150.

young subjects a portion of the epiphysis can be saved, a very great advantage is gained. I believe, however, that this can rarely be done, and we must, therefore, calculate upon considerable arrest of growth after the operation.

Now, I consider that this point has been urged too strongly against excision in young children.

It must be remembered that the limb with which we have to deal is already, if not considerably wasted, condemned, even under the most favourable circumstances, to a stunted growth. Supposing after the lapse of some time a cure of the disease is effected, and the limb is left in a tolerably straight position, we shall yet find that its growth is arrested, and that as years pass on considerable difference of growth will be found between it and its fellow. This difference between the two limbs is, however, to a great extent remedied by the use of some simple apparatus, and it must be within every one's knowledge how easily the owners of limbs distorted by knee-joint disease move about upon a high-heeled shoe or a short peg. As Sir William Fergusson has pointed out, the presence of the foot is the great help to progression which these cripples have. Upon it rests the whole weight of the body, and under it can be conveniently fixed the required apparatus.

This result is considered not unfavourable, and it is undeniable that the patient is placed in a far better position than if he had suffered amputation of the thigh. But it must be remembered that,

favourable though the result is, it has been arrived at after a very considerable lapse of time, and probably protracted suffering, with a chance, too, as I have before pointed out, of a return of the disease.

Now, supposing excision of the joint had been performed at an early stage, and that the limb had ceased to grow in proportion to its fellow, is the patient in a worse position than that just described? I think not. In all probability he will have a limb, perhaps as short, but it will be a straighter one, and one from which all diseased tissues have been removed, and the probable recurrence of disease prevented. But the point we are now considering is, not whether cure without any operation should be attempted, but which of the two operations—excision of the knee, or amputation of the thigh, should be had recourse to. On this question I can hardly conceive how there can be much difference of opinion. That a limb terminating in a sound foot, however much shorter than limb may be than its fellow, is superior to a stump in the middle or lower third of the thigh, appears to me self-evident. After all, too, a few inches of shortening, more or less, can make but little difference, certainly not enough to give the preference to amputation of the thigh.

If the shortening after a case of excision amounts to, say, three inches, we are not disposed to quarrel with the result, and a high-heeled shoe well supplies the deficiency. Surely a mechanical appliance,

twice this length, or even two thirds longer, is vastly superior and more manageable than a wooden leg of three or four times the length. And it is also worth considering that, as this operation is one more frequently performed on persons of the poorer class, it becomes a matter of importance that the apparatus they are condemned to wear for life should be as simple and cheap as possible. I have known cases where, after amputation of the thigh, the patients have never been able to obtain a wooden leg on which they could walk; principally because they were unable to afford a good one. Now, it is within the reach of every one to obtain a high-heeled shoe, or a shoe with an iron peg fastened to it, with which the patient can walk with the utmost facility.

Few surgeons have, perhaps, had greater opportunities of watching the results of excision of the knee in children than Mr. Holmes. He thus writes on this matter:—"That a limb may be shortened, even to a considerable extent, yet be far more useful than a thigh-stump, many cases prove to demonstration. I would refer to the three mentioned at p. 486. In that, under my own care, the boy, notwithstanding the shortening,* is nearly as active as his fellows; and I have often shown him to my class at lecture, in contrast with another of about the same

* "The shortening increased progressively as the boy grew, till, at the age of eighteen (about five years after operation), it reached $4\frac{1}{2}$ inches."—Holmes's 'Surgical Treatment of Children's Diseases,' *note*, p. 475.

age, on whom I performed amputation, after attempted excision, about the same time—now seven or eight years ago. The lad who was amputated has been able to procure a most excellent artificial limb, one of the best I ever saw, with which he can walk for short distances with a very trifling limp; yet he is far inferior in activity to the patient after excision.”*

That the shortening of the limb is sometimes very considerable cannot be denied. In the case of Mr. Pemberton, so often quoted, he removed three inches and a quarter of bone; but, at the end of six years, the limb was nine inches shorter than its fellow. Even, however, when the whole epiphyses are removed, the arrest of growth is not often so marked.

In a case of excision of the knee before alluded to performed by Mr. C. Heath on June 29th, 1858, on a boy, æt. $11\frac{1}{2}$, the whole joint, including the epiphyses, was removed; and the following measurements were taken in June, 1860, two years after the operation.†

Height, 4 feet 6 inches.

Right side.

From anterior superior spine of ilium to	
lower border of patella	13 inches.
From thence to inner malleolus	$10\frac{1}{2}$ „
Total	<hr/> 23 $\frac{1}{2}$ „

* Holmes's 'Surgical Treatment of Children's Diseases,' p. 486.

† 'Lancet,' July 7th, 1860.

Left side.

From anterior superior spine of ilium to	
lower end of femur	11 inches.
From thence to inner malleolus	10 „
	<hr/>
Total	21 „

Showing a difference of exactly $2\frac{1}{2}$ inches.

I was able to obtain the measurements of this case again on December 11th, 1865.

Height, 4 feet $9\frac{1}{2}$ inches.

Right side.

From anterior superior spine to patella .	$16\frac{1}{2}$ inches.
From thence to inner malleolus	$12\frac{3}{4}$ „
	<hr/>
Total	$29\frac{1}{4}$ „

Left side.

From anterior superior spine to lower	
end of femur	$12\frac{1}{2}$ „
From thence to inner malleolus	$12\frac{1}{4}$ „
	<hr/>
Total	$24\frac{3}{4}$ „

Showing a difference of $4\frac{1}{2}$ inches.

Thus, in a case where the entire epiphyses were removed, the loss of growth has been only two inches in five years and a half.

This case also illustrates the fact, that the tibia, having lost its upper epiphysis, yet grows more longitudinally than the femur which has lost its lower epiphysis. Here the femur, as compared with its fellow, has lost four inches; whilst the tibia, compared with *its* fellow, has only lost half an inch.

The cause of this has been fully explained, in a former portion of this essay, when treating of the growth of the bones after excision of the knee. I append woodcuts of this case, showing the condition of the limb two years after the operation, and at the present time (Figs. 30 and 31).

FIG. 30.

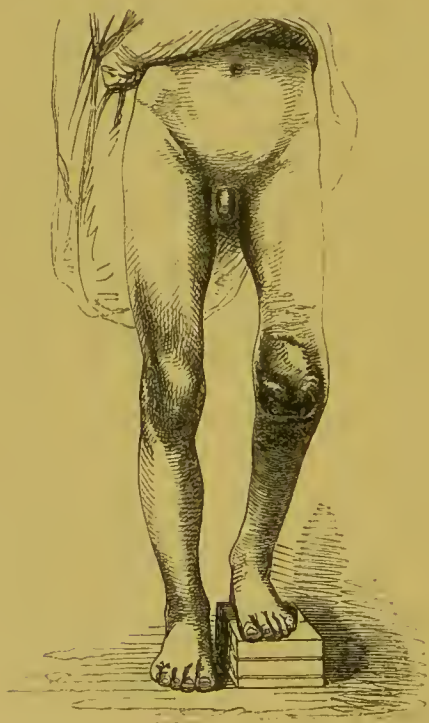


FIG. 31.



This case also serves to illustrate another point

about which considerable controversy has arisen. It has been asserted that not only does the limb after excision fail to grow in length, but that it ceases to enlarge in circumference, and that its general symmetry is altogether lost. This is, no doubt, in some cases so; but, in the majority of instances, I believe the contrary is the case. Here are woodcuts taken from casts of this boy's limb. Fig. 32 represents the condition of the parts in the year 1860. Fig. 33 shows the improvement which

FIG. 32.



FIG. 33.



had taken place subsequently, representing the limb in the year 1865. This fully bears out the remarks quoted from Sir William Fergusson's lectures at p. 67, where he states that from his own experience he can affirm that limbs after excision enlarge in bulk and improve in muscular energy.

Still further to illustrate the fact that a very great amount of shortening is better than a wooden leg, let me call attention to this woodcut (Fig. 34).

FIG. 34.



It represents a youth upon whom, in 1857, Mr. Kempe, of Exeter, performed excision (see Appendix, Case 58). At the time of the operation the boy was nine years old. The photograph from which this woodcut is copied, was taken in 1865, eight years after the operation. It appears that the boy left the hospital, and went into the country before good union had taken place: hence the bowing of the leg. Mr. Bedell, of Tiverton, writes me the following description of his condition in December, 1865:

“Ellis is now in good health and strong; the leg operated upon is eight inches shorter than the

other. He is learning a trade (shoemaker); he walks well, and at the rate of four miles an hour; he can walk fifteen miles in a day without any inconvenience or pain; he generally uses an ordinary walking-stick, but more to steady himself than from any use he makes of it to assist him; he wears a high-heeled boot; the heel is nine inches from the ground when standing, the toes four inches and a half; the foot is smaller than the other by an inch in each direction."

Yet another case, again operated on by Mr. Kempe, of Exeter, in 1860 (see Appendix, Case 60), at the age of eleven. The following is a woodcut (Fig. 35) representing the condition of the girl in

FIG. 35.



December, 1865. She, too, was from Tiverton, and Mr. Bedell kindly gave me following description of her:

"Ellen Bartlett, æt. 17, general health good; the

heel is five inches from the ground; the toe rests on the ground, she walks without a high-heeled boot, is strong, and can do three miles without inconvenience; works at a lace factory, and is standing all the day long. The limb measures eleven inches and a half at the knee, and eleven inches at the calf; the foot is of the same size as the other."

As a pendant to these cases, I may refer to one reported in the 'Medical Times and Gazette' of January 5th, 1861, by Mr. Henry Smith, where, on April 28th, 1855, the limb was reported to be exactly two inches and a quarter shorter than its fellow. In January, 1861, the shortening amounted to four inches. Thus, in six years, the limb had only lost an inch and three quarters in length.*

Results such as these are, I think, sufficiently favourable to encourage the surgeon to excise the joint at an early age. The question to be decided is, at what period of life is the limb sufficiently developed to provide a useful limb after excision, supposing its growth to be very materially checked? And, in deciding this point, we must bear in mind that the preservation of the foot is one of the great aims of excision of the knee.

Incurable disease of a young child's knee-joint is most frequently chronic in its character, and from its long existence has probably already arrested the growth of the entire limb.

* See also a letter by the late Mr. A. M. Edwards, quoting a similar case, in 'Medical Times and Gazette,' February 16th, 1861.

We have to run the risk of a still further arrest of development after excision of the joint. In this arrest of course the foot shares, and if this member be so small and stunted as to serve little purpose in sustaining the weight of the body, it is hardly worth preservation.

There are, of course, many reasons which would influence the surgeon as to his decision; but, as a general rule, I do not think that excision of the knee should be practised on children under the age of ten years.

Mr. Holmes recommends the age of fourteen as the most favourable age for excision, but I do not understand him to preclude the performance of the operation before that period of life. In those four critical years between ten and fourteen we find so many children having diseased knee-joints, that I should be sorry to exclude them all from the benefits of excision by the laying down of any arbitrary law. We must be guided here, as in many other surgical undertakings, by the dictates of common sense, and I think that common sense must teach us, that excision of the knee in very young children is inexpedient, whilst I may almost say humanity will prompt us to do our utmost to save our little patient's limbs whenever it is possible.

Before leaving this portion of my subject, I will refer to a paper written by Mr. Holmes Coote in the 'St. Bartholomew's Hospital Reports,' 1865, p. 194.

He writes :—

“I maintain that too great importance is attached to the exclusive influence of the epiphyses upon the growth, and that, in whatever region of the body the operation of resection is performed, the great danger consists primarily in the nerve-shock to the patient, and secondarily in the consequences of extensively opening the cancellous tissue of the bone and in the prolonged period of convalescence. In all cases, or nearly so, the limb is withered, small, and weak; and, in many instances, it is useless, or nearly so. When performed on the young, growth only adds to the consequent deformity; when performed on the adult, the attendant dangers are immeasurably increased.”

This is a very wholesale condemnation of the operation for excision of the knee; and the statements are really very much at variance with the general results of such cases. In referring to the quotation, I must point out the inconsistency of the writer, because I find that on April 18th, 1865, Mr. Holmes Coote excised the knee-joint of a female, æt. 15, and on August 20th she is reported as being able “to leave her bed. *The result is satisfactory.*” On May 6th, 1865, he also excised the knee-joint of a boy, æt. 13, who on August 21st is reported as being “convalescent, and he will soon be able to leave his bed.” It appears to me that the author of the paper hardly practises what he preaches; and that, if he holds the opinions expressed above, he should refrain from so barbarous a proceeding as excision of the knee. Seeing, however, that he

practises that operation with apparent success, I think he gives it but scant justice in his writings.

With regard to the age after which excision should be performed, I think it should never, under any circumstances, be undertaken in patients above the age of forty-five years. I have here fixed what, in my own judgment, is the utmost limit. I would rather excise a knee-joint in a patient before the age of forty than after. The powers of reparation in advanced life are not sufficiently strong to give the patient much chance of a useful limb, or to support him through the long after-treatment.

In concluding my notice of the treatment of diseases of the knee-joint by excision, I would remark that, if the immediate effects of the operation be not as satisfactory as the surgeon could desire, a great deal of patience should be exercised in endeavouring to bring about a successful termination of the case. It is not always, unfortunately, that we can put our patients on their legs at the end of six weeks (see p. 138). Very many circumstances may combine to retard the ultimate cure. In young patients especially the presence of caries in the heads of the bones often keep open sinuses, out of which a copious purulent discharge is constantly issuing. In very many such cases, continuous rest, good diet, and change of air, will eventually bring about a perfect cure; but the surgeon may often expedite this by cutting down on the disease, and gouging out the carious bone, leaving a cavity surrounded by healthy tissue, which will soon be filled up by

fibrous material, and in no way interfere with the after-results of the operation. This process may in the same case be resorted to more than once, until, as Sir William Fergusson has expressed it, by constant and patient *picking* at the disease, we eventually remove the entire mass, and the sinuses heal up.

If, however, the surgeon has reason to believe that the ends of the bones are still diseased, he may adopt a yet bolder proceeding, and have recourse to re-excision of the diseased extremities. Thus it is possible to obtain healthy bony surfaces, and ultimately firm union.

This practice has not yet, I think, become a thoroughly recognised proceeding amongst surgeons. At King's College Hospital it is looked upon as a matter of course that no limb should be amputated after excision without an attempt, at any rate, being made to remove the existing disease by a still further excision of bone. In the 'Lancet' for 1862, vol. i, p. 382, will be found a record of a case in which Sir William Fergusson attempted re-excision, but was obliged to complete the operation by amputation through the original site of the knee-joint.

In the appendix (Case 37) is given the history of a case in which Mr. Henry Smith successfully re-excised.

The limb was quite stiff and straight, but there were sinuses leading to diseased bone, and the soft tissues all around were much diseased. A bit was sawn off from the tibia and femur, and in the pos-

terior portion of this bone was found a groove in which lay a piece of necrosed bone with a bit of ligature thread twisted round it.

The boy was discharged in a very promising condition, and the last report about him was very good, the limb being quite straight and stiff, with three inches of shortening.

Another case of re-excision was performed at St. George's Hospital this year by Mr. Henry Lee, under different circumstances to the one just related.

In 1867 Mr. Lee had excised the knee-joint of a boy, æt. 7, for strumous disease.

He was sent to Margate, but was re-admitted with only soft fibrous union between the ends of the bone. This fibrous material was removed, the bones re-adjusted, and the boy recovered with a good limb.

In the first of these cases, although there was bony union, yet there was diseased bone, keeping up continual discharge, and open sinuses. The removal of this diseased bone procured a rapid cure.

In the second case there was failure to procure osseous union, and the removal of the fibrous ankylosis enabled the surfaces of bone to be brought into contact, and union between them soon took place.

These cases very well illustrate the conditions of limb which require re-excision, and I have no doubt that this proceeding will, ere long, become much more general than it is at present.

In cases where the ankylosis is simply fibrous,

and of so slight a nature as to prevent the use of the limb, time and change of air will work wonders; and very frequently, when both patient and surgeon are nearly tired of waiting, osseous union commences, and progresses rapidly. Great care must be taken during this period that no distortion of the limb takes place. A stout leather splint, carefully moulded and laced up in front, is the best preventive; but, even with it, a watchful eye should ever be kept on the limb, and any tendency to displacement immediately corrected by the application of appropriate apparatus. A light, but strong iron bar, running down the outer side of the leather splint, I have found an excellent preventive to the bowing outwards, which so frequently takes place, and of which Figs. 31 and 34 are examples.

One of the great arguments against excision of the knee-joint is this fact which we are now noticing; viz. the prolonged convalescence of the patient, and the frequent uselessness of the limb after all. I do not think that the first part of this objection is by any means a sound one. In the first place, it is proved that, in some cases, excision of the knee-joint makes as rapid a recovery as amputation of the thigh; and, on the other hand, there are very many cases of prolonged convalescence after amputation of the thigh; and it frequently happens that a considerable period elapses after the so-called cure of the case, before the patient can bear on the stump any apparatus with which he can walk about. In addition to this, supposing that, in the ordinary run

of cases, the time after excision is longer before the patient can walk on the limb than after amputation before he can bear a wooden leg, yet surely the prolongation of convalescence in the former case is a good investment of time, for it promises a leg of flesh and bone, with a good foot at the end of it, instead of a wooden leg, which, under the very best circumstances, is a life-long encumbrance to the patient. With regard to the second part of the objection, as to the ultimate uselessness of the limb, I fear that many surgeons are too hasty in their condemnation of these after-excision limbs. Thus many are condemned to amputation because they “hang like flails,” before time has been given, and every means used to procure osseous deposit in the fibrous tissue connecting the bones. Or, again, surgeons shrink from having recourse to such minor operative procedures as the removal of a small quantity of necrosed bone, whilst they rush headlong to the capital operation of amputation of the thigh. We have yet to learn, in the treatment of these cases, from the very first, some of those lessons of patience inculcated by Mr. Hilton, although I am sure that virtue will seldom be so severely taxed as he would have it to be.

Reference will be again made to this subject, in treating of amputation of the limb after excision.

Before proceeding to the consideration of amputation of the limb, I wish to call attention to what may be called a sort of intermediate step between the two operations. It has been very well remarked

that, however deep may be our insight into disease, we may sometimes be mistaken as to its extent. Mr. Cadge, of Norwich, in a letter to Mr. Price, published in his Essay, states that he has frequently opened the joint and examined its condition before deciding to amputate. I think this plan of exploration an admirable one. There are very few cases of knee-joint disease, except where the constitutional condition of the patient demands amputation, where this plan might not be pursued with advantage. I would, however, proceed a step beyond the mere opening of the joint, and saw off the articular ends of the bone as well. There can then be no mistake as to our diagnosis; and it may sometimes happen that we shall have the extreme satisfaction of saving a limb to the patient which had previously been condemned to amputation. Certainly we should be saved the remorse (for such *should* be our feelings) of ever having removed a limb that might have been saved by the simple excision of the knee-joint. In the Appendix (Case 94) will be found a case of this nature, in which I completed the operation by amputation. The condition of the bones, which were extremely carious, was a sufficient warrant for this proceeding.

CHAPTER X.

Amputation of the Thigh for Disease of the Knee-joint—Methods of Performing the Operation—After-treatment—Results—Diseased Conditions requiring Amputation.

THESE conditions I have designedly retained for consideration until the last, because amputation is the final procedure to which the surgeon can have recourse. I have already, as a matter of necessity, referred to many conditions of disease in which the operation of excision of the joint is not admissible, and where it becomes necessary to remove the limb by amputation through the thigh, in order to save the patient's life. Now, it becomes a question of great import, whether the surgeon is justified in resorting to amputation of the limb in disease of the knee-joint for any other reason but to save life. Amputation of the thigh is a very serious proceeding, fraught with great danger to the patient, and resulting, under the most favourable circumstances of recovery, in the loss of "a perfect foot, a nearly perfect leg, a considerable portion of a nearly healthy thigh."* The surgeon may well pause ere

* 'Lectures on Progress of Anatomy and Surgery during the Present Century.' By Sir William Fergusson. Lecture v, p. 107.

he performs so serious an operation upon his patient; and as long as any chance remains of saving the limb, the patient's life not being risked by the delay, the operation should be put off.

Still it must fall to the lot of every practical surgeon sometimes, however much he may endeavour to avoid it, to be obliged to amputate the limb for disease of, or injury to the knee-joint; and I now propose to consider those cases which absolutely require this interference. But, before doing so, I shall refer, as in the case of excision of the knee, to the operation itself.

For reasons which I shall mention afterwards, the operation should always, if possible, be confined to the lower third of the thigh. It is seldom that the femur is so far implicated as to require section above this point. It must be remembered, however, that in amputating the thigh in the lower third, there is a very great tendency for the femur to project forward through the wound, on account of the dragging of the hamstring muscles on the posterior flap. This defect might be remedied by making Teale's rectangular flap;* but I do not think that his plan is applicable here, as it necessitates the division of the bone too high up. It is proved by calculation that, if the transverse incision be made just above the patella, it would be necessary to divide the bone eleven inches above that point, to obtain the right proportion in the flaps. This, however, must be remembered, that in long standing disease of the

* Teale, 'On Amputation,' p. 34.

knee-joint the thigh is generally much attenuated, so that the circumference being less, the division of the bone need not be made so high up.

The plan adopted by Mr. Spence, of Edinburgh, with a slight modification, is a good form of amputation; provided, of course, that the skin and surrounding soft tissues are healthy. A large anterior flap is made, including as much muscle as possible. A very short posterior flap is then cut, the integument being dissected from the muscles, to free it from the contractions. The bone may then be divided very low down; and, the flaps being brought together, an excellent pad will be formed for the end of the bone, and the cicatrix of the wound will be sufficiently posterior to avoid pressure.

Mr. Carden, of Worcester, has published a paper in which he describes an operation very similar to this, and gives numerous woodcuts, showing admirable results. His plan is to make a single anterior flap of skin and fat only. When amputating in the neighbourhood of the knee-joint he cuts a semi-oval long flap in front, carrying the incision below the patella. This flap being reflected, the soft parts behind are divided, either by transfixing and cutting only, or by cutting from without inwards. The remaining soft parts in front are then cut, and the bone divided a little above the plane of the muscle. The skin-flap then falls over the face of the stump, and is united by sutures to the posterior integuments.

Mr. Carden thus sums up the advantages of this

plan of operation:—"The facility afforded for amputating, either through the knee, or through any part of the lower end of the femur; thus proportionately avoiding the shock of higher amputation, and the risks of exfoliation, pyæmia, &c., attendant on sawing through a cylinder of the bone; the simplicity of the whole proceeding, and small extent of the wound; the favourable position of the flap for dressing, and for the escape of discharge; painlessness and quietude of the stump, the principal nerves being divided high up and drawn out of reach of pressure or exposure; the fitness of the stump to stand and walk upon; the bearing being broad, and the skin employed being accustomed to bear the weight of the body in kneeling; the cicatrix being drawn clear of the front of the bone, out of the reach of pressure."*

Mr. Carden has himself tested this method of amputation extensively, and with very good results, and it certainly appears to me to be the best method applicable to the particular cases we are considering, viz. disease confined to the neighbourhood of knee-joint.

If the disease of the bone or soft parts necessitates an amputation higher up, Teale's, or the ordinary anterior and posterior flap operations will be serviceable. Pus burrowing high up amongst the muscles is no indication for a high operation, as the removal of the cause of the abscess will very soon cure it.

* 'Brit. Med. Journ.,' April 16th, 1864.

I have already referred to the necessity for extreme "conservatism" in amputation of the thigh; and I have done so because it has been proved that in proportion to the advance of the section up the thigh is the rate of mortality following the operation. The following is a table extracted from Macleod's 'Notes on the Crimean War,' showing the rate of mortality following amputation of the thigh in various parts :

At the upper third . . .	87·1 per cent.
„ middle third . . .	60·0 „
„ lower third . . .	56·6 „
„ knee-joint . . .	55·5 „

Thus it will be seen that the saving a few inches of femur materially lessens the chances against the patient.

It is possible that, in some exceptional cases, where disease is not much advanced, but the constitutional condition of the patient demands amputation, the operation may be performed through the knee-joint, the diseased articular surface of the femur being sawn off. The flaps may be made either by cutting a long anterior flap from the front of the knee and tibia, disarticulating the knee-joint, and cutting nearly straight out behind, or else by cutting a short flap in front, and a long muscular one from the calf. The former plan is, I think, the better one. This amputation has been performed with the best results, and, when it can be practised, must conduce to the safety of the patient. I have had the care of cases

of amputation through the knee for disease below the joint, and can testify to the admirable stump which is thus formed.

In securing the bleeding vessels at this point, a hint given by Mr. Carden is worth remembering. He has found that the stroke of the popliteal artery tends to keep open the mouth of the vein through which secondary hæmorrhage occurs. To avoid this he separates the artery from the vein for about an inch. I have more than once had exceeding difficulty in securing the popliteal artery, owing to the distance to which it retracts. It is quite possible to lay hold of the vessel with a tenaculum before it is divided, a proceeding which avoids much after-trouble and delay.

Into the vexed question of the ligature *versus* the needle or torsion, it is not my province to enter further than to remark that I am not yet sufficiently convinced of the enormous evils attending the use of the ligature, to induce me at the present time to relinquish it for either of the other methods now in vogue.

In bringing the flaps together I have given up the use of wire sutures, as there is no benefit derived from them, and their removal is a source of great pain to the patient. Moreover, the ends are apt to catch in everything with which they come into contact, and so give rise to a great deal of needless distress and irritation.

“It has not appeared to me,” remarks Humphry, “that metal offers any decided advantages as a

material for sutures over thread or silk, provided these be properly, not too tightly tied; and certainly, if there is much tension, the metal cuts its way out sooner than the others, and is, therefore, less serviceable. This I have found by inserting thread or silk, and metal sutures alternately, in the same wound.”*

The after-treatment should be of the simplest. In the majority of cases there is not the slightest necessity for the application of any dressing whatever—at any rate, for some days. After the removal of the sutures it may be needful to apply a couple of broad strips of plaster to prevent the edges of the wound from gaping. The less the stump is meddled with, the less pain is inflicted on the patient, and the better his chance of rapid recovery. One application I find very useful, especially when the flaps are rather large and heavy; and that is a back splint of gutta percha, moulded to the posterior surface of the stump, and retained in its place by a turn or two of bandage. In the ordinary run of cases, the wound is healed in about a month or six weeks; but, at the end of that period, it frequently happens that sinuses still remain open, which require a long period of time for perfect cure. Even when the stump is perfectly healed, and the case pronounced “cured,” it is still a considerable period before the patient can bear the application of any apparatus on which to walk. Taking an ordinary case of excision of the knee, and an ordinary case of

* ‘Brit. Med. Journ.,’ August 13th, 1864.

amputation of the thigh, I believe that the one will walk on his foot pretty nearly as soon as the other on his wooden leg.

The after-results of amputation of the thigh are not always as satisfactory as we could wish, and present nearly as many drawbacks to the operation as exist to excision of the knee. A very frequent bad result is conical stump, even after an apparently good pad of soft tissue has been provided. Mr. Hancock has referred, in the 'Lancet' of July 23rd, 1859, to a condition of "painful cicatrix and irritable stump." In the former, the skin is in close contact with the periosteum; and, instead of dissecting out the cicatrix, which is the usual mode of treatment, Mr. Hancock is in the habit of performing "sub-cutaneous separation of it from the periosteum," and preventing adhesion again taking place by constantly moving the skin backwards and forwards. In irritable stump, Mr. Hancock pursues the same method, thinking that the pain arises more from the adhesion of the skin to the bone and periosteum, than from the implication of the nerve or its bulb (Appendix, Case 100). Barwell quotes a case of Mr. Hancock's where amputation of the thigh was twice performed for this condition, and lastly, that of the hip, after which the patient died.

Necrosis of the end of the femur is another troublesome condition, which much delays the cure. If the periosteum be stripped back from the bone during the operation, a ring of bone will, in all probability, exfoliate. I saw, not long since, a

stump removed just below the *trochanter major*, in which the remaining shaft of the femur had died, and was enclosed in new bone. Thus, like the operation for excision, the recovery from amputation of the thigh is not always rapid or free from after-complications. It has, however, escaped the severe criticism to which its sister operation has been subjected, and is often allowed to bear off the palm for rapidity of convalescence, and decreased danger to the patient.

The statistics as to the mortality following amputation of the thigh are, like those of excision of the knee, not very reliable. Certainly, in this respect, our country hospitals are in advance of those situated in large cities—a fact which, of course, we are not surprised to learn. Thus, at the Exeter Hospital, out of 119 cases of amputation of the thigh, only ten died; and at the Plymouth Hospital, out of about forty cases, only three have died.

Against these figures I must put the figures of excision of the knee-joint in these two institutions, given at p. 63, and placing these results side by side we see that the same causes which influence the success of amputation, in all probability, equally affect excision.

But to return to the statistics of the mortality after amputation of the thigh. The results of amputation of the thigh out of England are truly appalling.

From various foreign sources Price has collected a number of cases, which I tabulate.

Malgaigne	201 cases, 127 deaths.		
Bencdikt	36	„ 11	„
Jæger	23	„ 10	„
Roux	16	„ 9	„
Dupuytren	11	„ 9	„
Chelius	10	„ 1	„
	<hr/>	<hr/>	
	297	167	

This list shows a very frightful rate of mortality, equal to 56·2 per cent.; and it is a relief to turn from this to the more favourable statistics of the operation collected by other authors. Amongst these, Mr. Bryant has tabulated 1168 cases of amputation of the thigh.* Of these, 254 died, giving a per-centage of 21·7.

In another table, given in the same paper, 188 cases of amputation of the thigh for chronic disease of the knee-joint are given, with 41 deaths, or a per-centage of 21·8.

It has been stated over and over again by writers on the subject, that a comparison between excision of the knee and amputation of the thigh can only fairly be made, when the amputation of the thigh is performed for chronic disease of the knee-joint.

In other words, we are to eliminate from the statistics of amputation of the thigh all the unfavourable cases, such as traumatic injury to the joint, or acute suppuration, and obtain our percentage of deaths from a number of cases of chronic disease well known to afford the most favourable

* 'Med. Times and Gazette,' January 9th, 1869. p. 32.

results to amputation of the thigh. We are not, however, to extend this power of selection to the other operation with which amputation of the thigh is to be compared.

The cases of excision of the knee are all massed together indiscriminately, and it is not surprising that the death-rate thus obtained should compare unfavourably with that of amputation of the thigh.

It should be borne in mind, however, that excision of the knee has been repeatedly performed for other conditions than that of chronic disease of the joint. It has been performed, as I have shown, for traumatic injury to the joint, both as a primary and secondary operation, for acute suppuration, for deformity the result both of injury and disease, and finally, the operation has been frequently repeated, as a re-excision, on the same limb, with admirable results.

I have before, at p. 116, expressed the hope that excision of the knee will be more frequently used in traumatic cases, and I am confident that the results will bear favourable comparison with those of amputation of the thigh under similar circumstances.

To show, however, how difficult it is to arrive at right conclusions from any statistical information we have at present, I may refer to another and a larger table than Mr. Bryant's, collected by Mr. Carrick, and published in the 'London Medical Review' for March, 1862.*

The amputations recorded were performed in

* 'London Medical Review,' March, 1862, p. 427.

various hospitals in England and abroad, but they were all so-called pathological amputations, excluding all cases performed for injury or traumatic disease.

Here are tabulated 1413 cases of amputation of the thigh, with a mortality of 434, or 30·71 per cent. Thus we see that between Mr. Bryant and Mr. Carrick there is the very considerable difference of 9 per cent. of deaths following the operation of amputation of the thigh.

The usual causes of deaths after amputation of the thigh are pyæmia, shock, exhaustion, and secondary hæmorrhage. Of fifty-four cases of amputation for chronic disease of the knee-joint, quoted by Mr. Sansom in a paper read before the Medical Society of King's College, five died of pyæmia, two of shock, one from exhaustion, and one from tetanus. Pyæmia is, as this table indicates, the most fertile source of death after amputation of the thigh.

In Price's table of the causes of death, which occurred in the 238 cases of excision he collected, he gives ten deaths only from pyæmia. Thus, in the amputations of the thigh, the deaths were about one in eleven, whilst in the excisions they were only one in twenty-four.

This fact is well worthy of notice, because the occurrence of pyæmia has been held up as one of the chief objections to excision of the knee; and the fact that in that operation the cancellous structure of the bones is so freely exposed, was thought to be the chief cause. Now it appears, that pyæmia

is more than twice as frequent after amputation than after excision. Dr. Wilks, in his 'Pathological Anatomy,' p. 454, makes the following pertinent remarks on this subject:—

“There are particular sorts of wounds and injuries which favour the absorption of matter into the blood, and, above all, those where the bone is exposed; thus, after amputation and injuries to any part of the skeleton they are most common. Mr. Bryant informs me that half of the deaths from amputation arise from pyæmia, and my own experience confirms this. . . . It remains a question whether the putrid elements are conveyed through the medulla rather than by the solid or cancellous structure of bone; and in relation to this matter, whether pyæmia is less frequent after excision of a joint than after amputation.”

I believe the facts stated above to be an answer to this query; and that absorption takes place more readily from the medullary canal, than from the cancellous structure of the bones.

Death from shock, although not so frequent as from pyæmia, stands next on the list. It arises from the severance of large vessels and nerves, and from the great loss of blood which frequently attends the operation. The removal of so large a portion of the body, with the blood contained in the limb, is in itself a great shock to the patient. Death usually takes place in from twenty-four to thirty-six hours after the operation.

Exhaustion is but a sort of prolonged shock, the

patient never recovering from the immediate effects of the operation, but lingering on for days, or even weeks, and at last sinking, with all the powers of Nature thoroughly worn out.

Secondary hæmorrhage may occur at various periods, either soon after the operation from the open mouth of some vessel undetected at the time of operation, or from imperfect closure of the orifice at the time of the separation of the ligature, or from sloughing of the wound laying open vessels.

These are the principal sources of death after amputation of the thigh. I have shown that pyæmia is less prevalent after excision of the knee; and I am quite certain that the same may be said of shock. As a matter of personal experience, I am sure that the shock after excision of the knee is very much less than after amputation of the thigh. It stands to reason that it should be so. In excision, nearly all the causes of shock are avoided. No large vessels or nerves are divided, little or no blood is lost, and the limb still remains attached to the body. I do not deny that in some cases, especially if the limb be ill adjusted, the patient suffers more severe pain after excision than after amputation; but pain and shock are two very different matters—in fact, the entire absence of the former, not unfrequently, indicates the presence of the latter.

I have already shown that secondary hæmorrhage after excision may be avoided; at any rate, it is of far less importance than when occurring from a large vessel in a stump after amputation.

I now proceed more immediately to notice the diseased conditions of the knee-joint which require amputation through the thigh.

Perhaps the most pressing necessity for amputation arises in that condition of disease which we have noticed; viz. acute synovitis which has run on to suppuration, and destroyed the entire mechanism of the joint. I have referred to a case of Mr. Kempe's (p. 94), where excision of the joint was performed with excellent results; but, satisfactory as they may be to the surgeon who performed it, and upon whom the operation was thrust by the patient and his friends, yet there can be no doubt that amputation is the rule in such cases, when all other means have failed to procure remission of the severe symptoms which always accompany the disease. One of those means will doubtless have been free incisions into the joint; and these should be so made that they may form a portion of the incisions in the amputations should it be required. The disease is itself a great shock to the system; and although in its last stage amputation is positively necessary to save life, yet we cannot but feel that the dangers of the operation are very great, and that the chances are rather against than in favour of the patient. The other diseased conditions of synovial membrane requiring operative interference have been referred to when considering excision of the knee. I then stated that I believed there were few other cases, besides the one just mentioned, of disease of the synovial membrane

alone, which might not be cured without resorting to the knife.

The gelatiniform degeneration, when in a very advanced stage involving the whole joint-tissue, is, I believe, incurable, and is also very unfavourable for excision. It is just one of those cases where one would be loth to amputate without first endeavouring to save the limb by an exploratory excision of the knee; and, unless the bony tissue were then found to be in a very favourable condition, amputation had better be at once completed.

There is no diseased condition of articular cartilage, that I am aware of, which ever demands amputation of the limb. If the patient be worn out by pain and confinement, all other means having failed, relief should be sought, as before stated, in excision of the joint; but, as a primary proceeding, amputation of the thigh need never be resorted to.

It is more especially in diseases arising in or extending to the bones of the joint that we are called upon to remove the limb above the seat of the disease. In cases of diffuse inflammation of the bone, the joint being entirely destroyed, there is clearly no better means of relieving the patient than by amputating the limb. A preparation sent in with this essay very well showed this condition. The bones were entirely denuded of cartilage and inflamed. On making a vertical section of the femur and tibia, this condition was found to extend far into the substance of the bones, presenting a bright pink colour. When caries or necrosis is present in the ends of

the bones to such an extent as to leave very little sound tissue remaining, a shell of bone being almost all that is left, no benefit can accrue to the patient by the endeavour to save the limb. In both these cases, whilst every care is taken to save as much of the femur as possible, the section of the bone should be made well above the disease, which often extends high up into the shaft of the femur.

Case 94 in the Appendix well illustrates this condition. It was my intention to excise the knee-joint;

FIG. 36.



but when first I saw the patient his state of health would not admit of this proceeding; at a later period, I attempted to perform the operation, but,

finding the bones in a state of advanced caries, I amputated the thigh, and the boy made an excellent recovery. The woodcut illustrates the fact that very great disease of the bones may exist without much external manifestation of the extent to which it has gone.

There are many cases of so-called diffuse strumous deposit which are better treated by amputation, particularly in very young children enfeebled by disease, and with knee-joints quite disorganized. The history of such a case (Margaret Bolt) has already been given at p. 35. The poor little child much improved in health during her stay in hospital; but some few months after she left, to go to a miserable home, strumous abscesses formed in different parts of the body, and she at length died.

It sometimes happens that even although the joint itself is not much involved, the periarticular tissues are so diseased that little hope of saving the limb remains. I need hardly say that in such cases excision is quite out of the question, and it is often needful to amputate the limb in order to preserve the life of the patient.

The case of Thomas Bate, detailed in the Appendix (Case 98), is one in point. Here, in spite of much care, the case went from bad to worse, and, at last, I was reluctantly obliged to amputate. It was one of those cases of emaciated thighs where Teale's amputation was specially indicated, and the resulting stump was everything that could be wished.

I have before referred to the great objection which

exists to excision of the knee-joint when visceral disease is present. It often becomes the duty of the surgeon to decide as to what treatment he shall apply to a diseased joint, when his patient is affected with some other serious malady in addition to the joint-mischief. For instance, it frequently happens that tubercular deposit in the lungs is an accompaniment of knee-joint disease; and, probably from the extreme debility caused by it, the joint-disease goes from bad to worse, and is a source of constant distress to the patient. Moreover, there is no doubt that it acts as a direct irritant to the lung, and aggravates all the pulmonary symptoms. Now, as soon as this fact is established, it follows as a matter of course, that the removal of the cause of irritation is the proper course; and, as excision of the diseased joint is not admissible under the circumstances, nothing but amputation of the thigh remains. It is an operation quite justifiable, and calculated to prolong life; although, in all probability, the tenure of life will be but a short one. In the Appendix (Case 96) will be found the history of such a case.

This was a case of far-advanced phthisis. There was nothing in the condition of the joint itself to preclude excision, as the disease was confined to the surface of the bones; but the cavity in his lung at once decided me as to what I ought to do. He was a poor man; and, if I had sent him away with the joint, it would have been impossible for him to give it the rest necessary even to preserve him from great

pain. I do not think the man will live long; but I believe he will live longer than if the limb had not been removed. I believe it should be a rule of practice to remove by amputation a diseased knee-joint, if it be satisfactorily proved that it acts as an irritant to more important visceral disease.

One of the gravest considerations for the surgeon is the treatment of wounds and injuries of the knee-joint, when it becomes a positive necessity that the joint should be removed. I have already discussed this question, and have stated my opinion that it is possible to effect this by excision of the joint. The fearful mortality attending upon amputations of the thigh after injury is quite a sufficient warrant for the surgeon to look to some other method of treatment. There are, however, injuries to the knee of such a character as to necessitate the removal of the limb by amputation, at all risks. One of the most distressing cases I ever saw was under care of one my colleagues (Appendix, Case 93). The man was caught in machinery. He sustained a compound fracture of the left tibia, with severe laceration of the soft parts. There was also a lacerated and contused wound into the right knee-joint. The left leg was immediately amputated; but an attempt was made to save the right. Tremendous suppuration set in, the pus burrowing back amongst the muscles of the thigh; and, five days afterwards, the thigh was amputated. The patient died on the third day. Now, under similar circumstances, if I attempted to save the other leg at all, I should certainly follow

Mr. Kempe's plan, and perform primary excision of the joint, as I believe that much less suppuration and constitutional disturbance would have arisen.

The last condition requiring amputation to which I shall refer, is that of the limb upon which excision of the knee has failed, and where, consequently, it is either an encumbrance, or a positive source of danger to the patient. Of 238 cases collected by Price, thirty came to amputation at various periods after; and out of the thirty thus operated on, five died.

These amputations were performed at distances of time from the excision, varying from a few days to over two years. In many of these cases, there can be no doubt that amputation was performed where a little patience would have avoided it; the bones being found healthy, and union taking place between them. Profuse suppuration, the remains of diseased synovial membrane, necrosis and caries of the bones, were the principal causes for the amputation in the others. The fact of five only out of thirty dying after the operation proves my assertion in a former portion of this essay to be correct; * viz. that patients having undergone excision of the knee are seldom worse able to bear subsequent amputation than if it had been the primary proceeding.

It is a question of great importance to decide in any given case, at what period all hope of saving a limb, in which the knee has been excised, expires. Of course, if profuse discharge and continuous pain

* See p. 67.

so wear down the constitution of the patient as to place his life in jeopardy, there can be little question as to the immediate removal of the limb.

Case 92 in the Appendix is a fair example of the necessity for amputation when every means had been tried to save the limb after excision. It will be noted that the patient's urine had become albuminous. Had not this been the case I should have strongly urged the propriety of re-excision. But, under all the circumstances, there can be no doubt that amputation was the right proceeding.

The difficulty of deciding when an after-excision limb should be removed, does not lie so much in cases like the one above quoted, as in those where, perhaps, there are sinuses leading to diseased bone, and where the union is only fibrous, and of such a nature as to be perfectly useless. I have before laid stress on the necessity for great patience in these cases. Much, I think, depends upon the feelings of the patient himself. If his position in life be such as to make it very needful for him to get about as soon as possible, or if he be tired of his limb, and urge on the surgeon its removal, I should not hesitate to comply with his request, unless I had very strong grounds for expecting rapid improvement.

Bearing upon this subject are some very interesting cases reported by Mr. T. Smith in the 'Transactions of the Pathological Society,'* and which I have quoted at length in the Appendix (Cases 101,

* 'Trans. of Path. Soc. of London,' vol. xix, p. 342.

102, 103). The three specimens illustrate the condition of the after-excision limb removed by amputation.

In the first case, the description of the union between the femur and tibia is said to be "so close that the exact line of union between the femur and tibia is not discernible throughout the whole surface of contact."

The mischief which led to amputation was found to be extensive caries of the back of the femur just above the junction with the tibia.

This illustrates the statement I have made at p. 71, in describing the operation of excision.

It is much to be regretted that so excellent a limb came to amputation, but I suppose the great difficulty of getting at the back of the femur to remove the dead bone left no alternative.

The second case was amputated for non-union of the bones, and suggests whether re-excision might not have been employed with success.

In the third case there was firm bony union between the femur and tibia, but a large central necrosis was found in the head of the tibia, with a detached sequestrum. Mr. Paget had twice endeavoured to remove dead bone, and no doubt the circumstances of the case forbade a further trial.

The review, however, of such cases as these is most instructive. First, Cases 101 and 103 show what great and successful efforts Nature had made to obtain a cure; and secondly, the pathological conditions met with in each case clearly point out the

lesson before enforced in this volume,* that it ought to take a great deal to make the surgeon despair of an after-excision limb, and that no stone should be left unturned to save it, provided the endeavours are consistent with safety to the patient's life.

There are, however, indications of an entire lack of usefulness in some limbs, which should decide the surgeon in no longer allowing it to cumber his patient. We sometimes find cases in young subjects where the limb has not only ceased to grow longitudinally, but where nutrition seems to have been arrested in all the tissues. It hangs loosely from the femur, seemingly attached to it only by the skin and soft tissues surrounding what was once the knee-joint. The muscles of the calf are quite atrophied; the foot is small and undeveloped; the temperature much below that of the sound leg: in fact, there is every indication that it hangs almost lifeless, and quite useless to its owner. There is little or no prospect of amendment here; and I think the sooner amputation is performed the better.

I cannot refrain from quoting at length here the admirable remarks by Mr. Holmes in his 'Surgical Treatment of Children's Diseases' on the subject of amputation after excision.

"Under what circumstances is consecutive amputation necessary? I have amputated on account of rapid sinking from acute surgical fever, but never

* Page 151.

with success; and I have seen a case of this kind recover without amputation, in which the child seemed near death, in which also the bones had got much displaced, and were exposed, so that the light could be seen shining through between them from one side of the knee to the other. I was consulted in this case by the surgeon in charge of it as to the propriety of amputation, and dissuaded it; and I had good reason afterwards to be satisfied of the propriety of the conclusion to which we came; for I saw the child completely recovered, with firm ankylosis, and with the limb in good condition.

Nor am I at all in favour of hastily removing the limb, on account of flail-like union. In many such cases the limb gradually becomes more solid, in which process flying blisters appear to assist, and even where this does not occur it is often possible to give sufficient support by a well-fitting apparatus to enable the patient to walk. When disease persists or recurs in the articular ends of the bones, the case, as I have said above, is not beyond the prospect of cure; but in many such instances the patient gets so weary of constant and apparently hopeless suffering, that he insists on getting rid of his limb at any risk."

It sometimes happens that disease is again set up in the bones by violence. I remember a case where Sir W. Fergusson excised the knee-joint of a young woman, with a most excellent result. Some years after, she fell, and necrosis of the bones took place; Sir W. Fergusson attempted to re-excise, but was

obliged to complete the operation by amputation of the thigh.

I believe that all the varying circumstances demanding the operations of excision of the knee and amputation of the thigh have now been reviewed. I have endeavoured to perform this task in a fair, unbiassed spirit, neither unduly vaunting the merits of one proceeding, nor depreciating those of the other. I have contended that, whereas it is a glory to the surgeon to save both limb and life to his patient, he has no right unduly to risk the latter in attempting to save the former. Much as I admire, and desire to practise, in every fair case, excision of the knee, I have no wish to strike amputation of the thigh out of the roll of surgical procedures. It is a painful operation for the surgeon to undertake, and a still more painful and distressing circumstance for the patient to go forth maimed to so fearful an extent; but the prolongation of life is the surgeon's great triumph; and, if the loss of a limb to his patient is the cost at which this is procured, he must not hesitate to perform his duty. On the other hand, it behoves us as a Profession to be more careful how we deal out such full measure to our patients. A great and important addition has been made to our operative resources by the revival of excision of the knee-joint; and we must be careful how we allow either prejudice against, or ignorance of, the operation to prevent us from giving those who are under our care, and who may require it, the benefits of its use.

APPENDIX.

CASE 1.—Sir Wm. Fergusson. Female, æt. 29. Date of operation, May 10th, 1862.

Disease.—Anchylolysis of right knee, and distortion of limb from acute disease of knee-joint, set up by a needle which was driven into the joint during a fall. This accident occurred sixteen months before admission, and the foreign body remained in the joint for six weeks.

Result.—Patient discharged 105 days after the operation. Firm union, limb perfectly straight, about two inches shorter than left.

CASE 2.—Sir Wm. Fergusson. Male, æt. 25. Date of operation, June 14th, 1862.

Disease.—Osseous anchylolysis of twenty-three years' standing. Leg bent at almost an acute angle, bones of leg dislocated backwards; patella, femur and tibia united in a solid bony mass.

Result.—Discharged seventy-four days after the operation. A good straight limb, patient able to walk with ease.

CASE 3.—Sir. Wm. Fergusson. Male, æt. 15. Date of operation, July 19th, 1862.

Disease.—Chronic strumous disease of left knee-joint of six years' standing. Partial anchylolysis, soft parts about joint much thickened, leg flexed.

Result.—Forty-six days after operation was sent to Margate, as his health was failing. The incisions had healed, good union was being perfected; limb not much shortened.

CASE 4.—Sir Wm. Fergusson. Female, æt. 10. Date of operation, July 26th, 1862.

Disease.—Right knee-joint excised eighteen months before for extensive strumous disease. Result of this operation very successful, but the girl allowed to walk upon the leg too early, so that the uniting medium between the bones of thigh and leg yielded, and the limb became flexed.

A wedge-shaped piece of bone was removed and the limb straightened.

Result.—Patient discharged forty days after second operation with a straight limb. Union firm.

CASE 5.—Sir Wm. Fergusson. Male, æt. 6. Date of operation, May 17th, 1862.

Disease.—Ulceration of cartilage of left knee, great thickening of soft parts, large ulcer in the integument covering inner aspect of joint.

Result.—Discharged ninety-nine days after operation, with a straight limb and good union of the divided bones.

Small abscesses repeatedly formed around the joint for several months after operation, but the boy ultimately did well.

CASE 6.—Mr. Henry Smith. Male, æt. 29. Date of operation, September 6th, 1862.

Affection of joint.—Contraction of left leg and firm osseous ankylosis of left knee-joint; the result of a gun-shot injury received in the Crimea. A wedge-shaped piece of bone removed.

Result.—Ninety-four days after operation discharged with

a straight limb, very little shorter than right. Union firm and bony.

In 1866 was engaged as an overseer in a large slate quarry, was able to walk long distances without difficulty, and has not suffered from pain in the joint since discharged from King's College Hospital.

CASE 7.—Sir Wm. Fergusson. Male, æt. 7. Date of operation, November 1st, 1862.

Disease.—Strumous ulceration of cartilages of left knee.

Result.—At the end of third month was sent to Margate. Limb straight and union firm and bony. Parts about seat of operation sound.

CASE 8.—Sir Wm. Fergusson. Female, æt. 24. Date of operation, March 28th, 1863.

Disease.—Chronic strumous disease, of nine years' duration. Cartilages ulcerated and bone exposed.

Result.—Death from pyæmia on twelfth day.

CASE 9.—Sir Wm. Fergusson. Male, æt. 32. Date of operation, April 18th, 1863.

Disease.—Acute inflammatory disease, which commenced four months before in an attack of acute articular rheumatism. Right leg.

Result.—Discharged cured 100 days after operation. Right leg three inches shorter than other.

CASE 10.—Sir Wm. Fergusson. Female, æt. 13. Date of operation, July, 1862.

Disease.—Gelatiniform degeneration of synovial membrane of left knee.

Result.—Rigors, great depression, and symptoms of pyæmia came on soon after operation. The patient became very restless and the limb could not be kept in the extended

position. An extensive and very deep bed sore formed a little below left buttock. The patient recovered from the constitutional affection, and the wound made by the operation healed. The left limb, however, remained in a very unsatisfactory condition, firmly ankylosed at the seat of excision, but bent forwards at a very marked angle, so that only the point of great toe could be put to the ground.

In March, 1863, Sir W. Fergusson performed re-excision, and removed a wedge-shaped piece of bone. The limb was at once bandaged to a splint in the extended position.

The patient made a very rapid and good recovery, and at the end of six weeks was discharged from King's College Hospital with a firm, straight, though much shortened limb.

CASE 11.—Sir Wm. Fergusson. Male, æt. 8. Date of operation, May 23rd, 1863.

Disease.—Thickened synovial membrane.

Result.—Unsuccessful. Extensive necrosis of upper end of tibia. No union between ends of bone at the 195th day after operation.

January 28th, 1864.—Second operation, slice removed by saw from end of femur and tibia.

Recovery very slow. Patient ultimately discharged eighty-two days after second operation, with the left limb straight and firm, but very short.

CASE 12.—Sir Wm. Fergusson. Female, æt. 37. Date of operation, July 10th, 1863.

Disease.—Ulceration of cartilages of right knee, partial fibrous adhesion between ends of bones.

Result.—Went on well up to September 22nd, when a large abscess suddenly formed in right gluteal region, and was followed by pyæmia and death on the seventy-third day.

CASE 13.—Sir Wm. Fergusson. Male, æt. 24. Date of operation, July 11th, 1863.

Disease.—Chronic disease of left knee. Partial ankylosis and repeated attacks of acute inflammation.

Result.—Discharged on seventy-fourth day with a straight limb, one inch shorter than left. Union good.

CASE 14.—Mr. John Wood. Male, æt. 28. Date of operation, May 9th, 1862.

Disease.—Ulceration of cartilages and extensive caries of head of tibia. Patient very strumous and scarred on neck by large blue scrofulous sinuses and cicatrices.

Result.—Immediate results good, and patient sent out with a good straight limb. Disease, however, soon returned, and the thigh was amputated in King's College Hospital in February, 1864. Quick and good recovery.

CASE 15.—Sir Wm. Fergusson. Male, æt. 18. Date of operation, January 30th, 1864.

Disease.—Knee excised by Sir William in 1859; operation successful but followed after much use of the limb by bending and distortion. Leg fixed at right angle to thigh. Wedge-shaped piece of bone removed.

Result.—Patient after second operation made a rapid and good recovery.

CASE 16.—Sir Wm. Fergusson. Female æt. 14. Date of operation, February 13th, 1864.

Disease.—Chronic strumous affection of bones following typhus fever eleven years before.

Result.—Much hæmorrhage a few hours after operation. Death from exhaustion on third day.

CASE 17.—Sir Wm. Fergusson. Female, æt. 9. Date of operation, May 19th, 1864.

Disease.—Chronic strumous disease of six years' standing. Abscess in head of tibia.

Result.—Death from pyæmia on twelfth day.

CASE 18.—Mr. Henry Smith. Female, æt. 26. Date of operation October 29th, 1864.

Affection.—Anchylosis of knee, resulting from long-standing disease.

Result.—Death from pyæmia on thirteenth day.

CASE 19.—Mr. Henry Smith. Male, æt. 7. Date of operation, October 22nd, 1864.

Disease.—Strumous disease of five months' standing. Suppuration within joint.

Result.—Greater part of wound quickly healed, but abscess and sinuses subsequently formed around the joint, and there was no tendency for the bones to become united. Discharged on forty-eighth day and sent to Margate.

CASE 20.—Mr. Henry Smith. Female, æt. 21. Date of operation, January 12th, 1865.

Disease.—Strumous disease of right knee-joint of nine years' duration. Ulceration of cartilages and partial ankylosis. Two small abscesses in head of tibia.

Result.—Death from pyæmia on ninth day.

CASE 21.—Sir Wm. Fergusson. Male, æt. 15. Date of operation, January 6th, 1865.

Disease.—No active disease of joint, but ankylosis resulting from old ulceration of cartilages, leg fixed at an acute angle to back of thigh.

Result.—Discharged on 190th day, with a straight and firm leg. Shortening six inches.

CASE 22.—A boy, æt. 8, admitted into King's College Hospital, under Mr. H. Smith, with old disease of the knee, which resulted in permanent deformity, the leg being flexed upon the thigh, and the ankylosis being very firm.

Mr. H. Smith removed a wedge of bone on October 7th,

1865. The boy has made a good recovery with a straight though somewhat shortened limb.

CASE 23.—Mr. Wood. H. D—, male, æt. 4.

Strumous disease of the knee-joint, commencing in the bones; cartilage becoming involved. The patient was pale, flabby looking; the right knee was swollen, and uniformly soft; the skin covering it was pale; the joint was semi-flexed, immovable, and very sensitive. Four sinuses opened on the surface at the front part of the knee. No exposed bone could be detected on probing the sinuses, which were discharging puriform matter.

October 21st, 1865.—Excision was performed by a semi-lunar incision; the lower end of the femur and the whole of the epiphysis of the tibia were removed. A small abscess was found in the head of the tibia; the patella was healthy.

CASE 24.—Mr. H. Smith's case. M. B—, æt. 30, female, admitted September 6th, 1865.

Strumous disease of knee-joint commencing in the synovial membrane; joint greatly disorganised; pain and swelling in the joint commenced November 6th before, and this increased rapidly, the joint becoming gradually flexed. She went to St. Bartholomew's Hospital, when amputation of the limb was proposed; she would not submit to this, and came under Mr. Henry Smith's care into King's College Hospital. On admission the joint was swollen, red, fluctuating in parts, causing her great pain on pressure, and flexed.

21st.—Excision was performed; the joint was completely disorganised, and full of gelatinous matter; the lower end of the femur and the articular extremities of the tibia were removed.

The patient went on very well until six days after the operation, when Mr. Smith, finding the femur somewhat overriding the tibia, placed her under chloroform and changed

the splint. Two days after this, she got a rigor, symptoms of pyæmia were gradually developed, and she died on the eighteenth day after the operation. Mr. Smith fears he may possibly have carried infection to this patient from a patient with abscesses, the result of puerperal fever.

On *post-mortem* examination the limb was found in excellent position, but the ends of the tibia and femur, or rather their substance for the extent of an inch or more, were here and there infiltrated with pus. There were small circumscribed purulent deposits in one lung, and a collection of matter in the front of the pons Varolii, cerebellum, and fourth ventricle. Latterly, she had complained terribly of pain in the head.

CASE 25.—Mr. Henry Smith. Male, æt. 8. Date of operation, September 28th, 1865.

Disease.—Anchylosis of knee resulting from old disease.

Result.—Was sent to Margate November 29th, for the sake of his general health, but ultimately made a very good recovery, and was seen a few months back by Mr. Henry Smith walking about with a serviceable limb.

CASE 26.—Mr. Henry Smith. Male, æt. 30. Date of operation, January 6th, 1866.

Disease.—Anchylosis of left knee, the result of chronic disease. Joint immovable and leg semi-flexed. No active disease.

Result.—Rapid recovery; on forty-sixth day was discharged from King's College Hospital with a good sound limb.

CASE 27.—Mr. Henry Smith. Female, æt. 43. Date of operation, April 14th, 1866.

Disease.—Of nineteen years' standing. Joint (right) fre-

quently attacked by severe pain and inflammation. Synovial membrane thickened, cartilages ulcerated.

Result.—Death from embolism on eightieth day; the wound had healed, and there was firm osseous union.

CASE 28.—Sir Wm. Fergusson. Female, æt. 21. Date of operation, April 7th, 1866.

Disease.—Gelatiniform degeneration of synovial membrane of left knee; fifteen months' duration.

Result.—Death from pyæmia on twenty-second day.

CASE 29.—Mr. Henry Smith. Male, æt. 16. Date of operation, July 7th, 1866.

Disease.—Destructive inflammation of left knee-joint, the result of a slight injury.

Result.—Discharged on fifty-sixth day with the wound healed and fair amount of union. General health bad.

Patient re-admitted in January, 1867, with extensive disease at the lower end of left femur. On February 9th, 1867, excision was performed for the second time. The boy, though very pale and unhealthy, did well, and was discharged with a serviceable limb. Union between the ends of resected bones fibrous.

CASE 30.—Mr. J. Wood. Male, æt. 25. Date of operation September 29th, 1866.

Disease.—Chronic disease of joint (right) of sixteen years' standing. Cartilages ulcerated and a large abscess in lower end of femur, which opened into articulation. Health of patient much affected.

Result.—Death on nineteenth day, preceded by rigors, erysipelas, sloughing of edges of wound and hæmorrhage.

CASE 31.—Sir Wm. Fergusson. Female, æt. 25. Date of operation, November 16th, 1867.

Disease.—Gelatiniform degeneration of synovial membrane.

Result.—Did well up to 25th, when ehloroform was administered during the dressing of the limb. The patient never thoroughly reeovered, and died depressed and exhausted from vomiting, &c., on Deeember 2nd.

CASE 32.—Mr. Henry Smith. Female, æt. 12. Date of operation, Deeember 14th, 1867.

Disease.—Strumous, of nine years' standing. Synovial membrane thickened and pulpy. A small patch of uleeration in tibial eartilage.

Result.—January 4th, 1867.—Going on remarkably well.

CASE 33.—Notes of W. F. Clarke, and Martin Oxley, dressers.

James Haggarty, æt. 11, admitted into King's College, under Mr. Bowman's care, on February 6th, 1861.

He had previously been in the hospital from February to August, 1859, with his knee in much the same condition apparently as now. It was then put upon a splint, and extended till it was nearly straight. When he left King's College Hospital, he was able to walk pretty well by the help of crutches.

Eleven months before admission he disearded the erutehes, and ever since then the knee had been becoming more and more bent. On the 31st of last January he fell downstairs and struek it against a sharp corner; this gave him great pain at the time. A swelling began to form, and he was unable to use the limb as before; after being laid up at home a few days he was brought to the hospital on February 6th. The following was the eondition of the left knee :

The tibia was dislocated baekwards; the femur projeeting in front of it to the extent of about an inch. This made the eondyles appear prominent; immediately below them, and a

little to the outer side of the leg, the patella was firmly fixed; below this again, and also on the outer side of the joint, there was a soft elastic swelling, very tender and sensitive on pressure; below the joint, on the inner side of the leg, there was a hollow caused by the displacement of the tibia. The limb was bent at an angle of about 130 degrees, and was almost perfectly ankylosed. The patient suffered no pain, except in the swelling mentioned above; and he was able to walk, or rather to limp about, with the help of a stick, though he could only touch the ground with the toes of his left foot.

March 2nd.—Since his admission he had had a liberal diet, and rested his leg by lying in bed. By these means his general health had improved considerably, and the knee was no longer painful or tender. To-day he was taken down to the theatre, and placed under chloroform; Mr. Bowman then proceeded to resect the knee; a lunated incision, with long sides, was made, crossing the joint immediately below the patella. The skin was then dissected upwards, close to the bone, until about an inch and a half of the lower extremity of the femur could be removed with the saw; the tissues were next cleared away from the upper part of the tibia, and a thin slice—averaging less than half an inch in thickness—was sawn off; it was then found that the surfaces of bone could be brought into perfect apposition; one artery was tied; the flaps of skin were brought together, and united by three sutures; the leg was then laid on a McIntyre's splint, and a bandage applied above and below the knee; the seat of the operation being covered only by a little simple dressing. The patella was firmly united to the femur, and came away with that portion which was removed; the ankylosis appeared to be partly fibrous, partly bony. On a vertical section of the end of the femur being made, it was seen that the whole of the epiphysis had been taken away, as well as a portion of the shaft of the bone.

3rd.—Pulse 104; tongue clean and moist; he slept well after taking a draught, and was tolerably easy, and free from pain.

4th.—Pulse 120. To-day, as the femur seemed to project over the tibia, bandages were applied over the femur to keep it down; the straight splint was then attached to the McIntyre, and the limb extended; the wound was dressed with cold water.

7th.—Pulse 120; the bowels had been slightly moved by a pill, and his tongue was cleaner. The knee was tolerably free from pain, except when it was being dressed.

12th.—Pulse 130. Slept well last night and felt better this morning. The knee was tolerably easy.

19th.—Pulse 120; tongue clean; bowels open. Yesterday the splint was removed, and reapplied, care being taken to raise the tibia and depress the femur. To-day he was easier, and his spirits seemed better.

30th.—Pulse 130. Tongue clean; bowels open; the knee was progressing favourably; it gave him less pain; indeed it was quite easy, except just when it was being dressed; the incision was healing; there was sufficient discharge from the ends of the wound. To-day the splint was removed and reapplied, care being taken to depress the femur and raise the tibia, so as to keep the bones in a right line.

April 6th.—His appearance improved daily; there was little or no pain in the knee, except just when it was dressed. He slept and ate well. The incision was almost healed along the front, but at the ends there were openings, from which a free discharge took place.

22nd.—To-day the limb was taken off the splint, and a plaster of Paris bandage applied.

May 20th.—He could now walk slowly with a crutch, and could even bear the whole weight of his body on the left leg; the length of which, from the anterior superior spine of the ilium to the outer malleolus, was twenty-three inches and a

quarter; the right measured twenty-five inches and a quarter. There was a small sore on both the inner and outer side of the knee, which discharged a little. His health had improved very much; he expected to go to Margate every day.

22nd.—He went out to-day.

October 7th.—The leg that was operated upon measured twenty-four inches from the anterior superior spine of the ilium to the external malleolus, being two inches and a half shorter than the other. The boy's health was excellent. He walked a mile to the hospital this morning; he was on his legs all day; the limb had regained much of its plumpness, but remained thinner than the other; no movement could be perceived at the knee, but attempts at flexion gave a little pain, so that probably cartilaginous, and not osseous, union had taken place. The outer side of the incision still presented a small unhealed portion.

CASE 34.—R. C—, æt. 20, was received into King's College Hospital in December, 1866. She suffered extreme pain in the left knee, which had been swollen and disabled for nearly six years, during which time she had been under various kinds of treatment. There was no evidence externally of severe mischief, no abscess or sinus, but the knee was enlarged, ankylosed in the straight position, but horribly painful to the touch, and her nights' rests were completely destroyed by violent startings. The health was much reduced. Thinking that some relief might be obtained, Mr. Smith applied the actual cautery, and kept her quiet in bed for some weeks, but no benefit ensued, and on January 12th he removed the ankylosed knee, and on making the section through the bone found out the cause of the severe pain in the shape of an abscess in the cancellated structure of the femur. There was very little shock, but a rigor occurred on the fourth day and was twice repeated. Other symptoms of pyæmia set in, and she died on the tenth day.

On post-mortem examination diffuse suppuration of the femur was found, and sero-purulent effusion into the right pleura with consolidation of the right lung.

CASE 34.—J. S—, æt. 5, admitted under Mr. Smith with extensive disease of left knee. She had been under Mr. Smith's care for twelve months, the joint becoming gradually more enlarged and useless. Mr. Smith excised the joint on June 8th. There was great degeneration of the synovial membrane, but the bones were healthy. On the eighth day she had a severe rigor, which was repeated in forty-eight hours. This was followed by great depression, and she gradually got worse and died on the eighteenth day.

Post-mortem examination revealed diffuse suppuration of the cancellated tissue of the ends of the bones, abscesses in the lung, spleen and kidneys.

CASE 36.—W. P—, æt. 15, a strumous lad, was admitted in October, with disease of the knee. Mr. Partridge excised the joint in November. No bad symptom came on, and the boy was discharged at the end of March. He was examined in September last, when the limb was straight, with firm fibrous ankylosis and a useful limb.

CASE 37.—A strumous boy, æt. 12, admitted February, 1867, had previously been in hospital, and Mr. Smith had excised the knee in the previous August. He had made a good recovery, but the wound never healed entirely, several sinuses remaining. The limb was quite stiff and straight from ankylosis having taken place, but there was great swelling of the tissues about the site of the operation, and two or three sinuses led down to bare bone. On February 9th, Mr. Smith re-excised the parts. The bones were united by very firm fibrous ankylosis, a piece was sawn off both from tibia and femur, and on examining the latter there was found

a large groove at its posterior aspect, and a large portion of necrosed bone lay in it, and twisted round this piece of bone was an old ligature thread. The boy did very well, the knee became pretty firm; the limb was quite straight, and he was discharged in April with very little shortening. Mr. Bubb, of Cambridge, writes October 10th, a most favourable report, to the effect that the boy can walk with a stick, all discharge had ceased, and the leg was three inches shorter than the other.

CASE 38.—W. P—, æt. 10, admitted under Mr. Smith in March, 1867. A strumous and wretched-looking object. Disease in the left knee had been going on for some period. It was contracted, swollen, and very painful, and perfectly useless to him. There were no sinuses, but the elastic condition indicated disease of the synovial membrane. The joint was excised March 9th, and not a bad symptom occurred.

The boy was dismissed with a straight firm leg, and able to use it, on May 1st. In September last he was seen; the limb was straight, shortening scarcely perceptible, and ankylosis firm but fibrous.

CASE 39.—C. M—, æt. 12, admitted under Mr. Smith, May, 1867. A strumous boy, and had suffered from disease of right knee for four years. The joint was excised on May 19th, leaving half of the epiphysal extremities. There was great thickening and pulpy degeneration of the synovial membrane, but no disease of the bones.

Several ligatures were applied, but about two hours after severe hæmorrhage set in. The house surgeon found two vessels bleeding, which he tied, and applied perchloride of iron to the surface of the bone, which was bleeding. The boy lay in a critical state for some hours, but he again rallied and had no bad symptoms, and he was discharged

August 10th with a straight limb, firm knee, and scarcely an inch of shortening.

CASE 40.—H. W—, æt. 8, admitted under Mr. Partridge in June, 1867, with contracted left knee, swollen and very painful. In July the joint was excised. No bad symptoms came on, and he was discharged eight weeks after the operation with a straight leg and fibrous ankylosis.

CASE 41.—E. V—, æt. 14, admitted under Mr. Partridge in May, 1867. This boy's limb presented a most extraordinary appearance of deformity. The limb was contracted at the knee, the lower leg and foot twisted outwards in a most fantastic manner. The joint itself was much swollen and painful, and the tibia thrown backwards. On July 24th, the joint was excised. It was firmly ankylosed, but the bones were ulcerated and the synovial membrane thickened. He suffered a good deal from shock, the operation being long and difficult. After he had rallied from its immediate effects, the pulse became very rapid, his face anxious and dusky, and there was great tenderness in the groin. Symptoms of cerebral disturbance set in after a fortnight. He became most unruly, tearing off the dressings, &c. Pupils dilated. He was carefully watched, nourished, and stimulated, blisters applied to the nape of the neck, with large doses of bromide of potassium and cod-liver oil. He rallied from this condition, and the limb is now in excellent position, and the wound nearly healed.

CASE 42.—A. H—, æt. 25, admitted under Sir W. Ferguson, in December, 1866, in a wretched state of health and the knee-joint quite disorganised. Excision was performed on January 12th. There was extensive disease of bone and synovial membrane. There was also so great deformity that great difficulty was experienced in getting the limb into

position. She did well, and was discharged on March 16th to go into the country. The wound was not healed and several sinuses existed.

On October 12th a very favourable account was received, stating that union had taken place, but was not yet quite firm. Several exfoliations had taken place. The shortening was two and a half inches.

CASE 43.—D. B—, æt. 10, admitted under Mr. Wood, October 23rd, 1866, with disease of left knee, which had existed for several months. The knee was contracted, swollen and painful. The joint was excised on November 3rd, and an abscess was found in each condyle of the femur. There was also gelatiniform degeneration of the synovial membrane. The patient went on famously and was discharged December 20th quite well.

CASE 44.—J. M—, æt. 23, was admitted under Mr. Smith's care in July, 1867. There was great distortion, and the joint swollen, and a sinus led down to bare bone. The head of the tibia was dislocated backwards and outwards. There was great pain on pressing the knee. The joint was excised on August 3rd, the operation being a difficult one owing to the displacement. The limb was got into good position, and the case went on well. Union is now nearly complete, and the case will soon be, no doubt, discharged cured.

The man has suffered little or nothing since the operation.

CASE 45.—E. T—, æt. 6, was admitted under Sir W. Ferguson in May, 1867, with extensive disease of the left knee of three years' standing. Excision was performed on June 22nd. Extreme disease was found in the joint. The case progressed very slowly, but the child gained flesh, and now there is firm union at the knee, and the health is very good.

CASE 46.—J. M.—.æet. 23, was admitted into King's College Hospital, under Sir W. Fergusson, in July, 1867, with extensive disease of the left knee-joint. The limb was perfectly straightened, nearly stiff at the knee, which was painful, swollen, and riddled with sinuses. This man had been an inmate of the hospital just a year previously, but as the limb was in good position for eventual recovery, he was recommended to go to the sea-side; he remained at Margate for some months, but returned to the hospital without the least improvement whatever.

Sir W. Fergusson excised the knee-joint on Saturday, August 10th. On examination the disease was found to be very extensive, there being deep ulceration of the bone on the outer condyle of the femur and corresponding head of the tibia, besides other mischief. This patient did not experience a single bad symptom, and as the limb was quite straight at the time of the operation there was not the slightest difficulty in keeping it in the good position. The patient is now in good health, able to move about on crutches, fibrous union having taken place, and no doubt will soon be able to leave the hospital.

CASE 47.—A boy, æt. 14, of the name of Hendle, under Sir W. Fergusson, operated on November 21st, 1857. There was most extensive disease of the knee-joint, and displacement of the tibia backwards and outwards. This case went on uninterruptedly well, and was discharged February 9th. He was seen by our assistant house surgeon, Mr. Wileox, at the hospital last week, making good use of a firm and serviceable limb.

The following cases (from 48 to 58 inclusive) were under the care of Mr. Henry Lee, in St. George's Hospital.

CASE 48.—Benjamin B—, æt. 8. Date of operation, April 23rd, 1868.

Remarks.—An abscess was found in the internal condyle of the femur. Left the hospital July 1st, 1868. The wound was then quite healed and the bones ankylosed. He came to the hospital to show himself on the 22nd December, 1868. He could then walk and run with facility. The leg was about an inch shorter than the opposite one.

CASE 49. — F., æt. 7. Date of operation, June 30th, 1860.

Remarks.—This patient was in St. George's, Ormond Street, and King's College Hospitals. There was some necrosed bone in the head of the tibia. In October the wound made by the operation was nearly healed, and on the 3rd of November she was discharged from the hospital. The last note of the case says "the leg was of good length compared with the other."

CASE 50.—Patrick R—, æt. 24. Date of operation, November 24th, 1864.

Remarks.—Abscess and necrosed bone in head of tibia. Left the hospital March 1st, 1865. Could walk with crutches.

CASE 51.—Charles N—, æt. 11. Date of operation, December 14th, 1865.

Remarks.—Operation for strumous disease. Discharged May 2nd, 1866. Firm union. Limb nearly two inches shorter than the other.

CASE 52.—Henry N—, æt. 13. Date of operation, January 18th, 1866.

Remarks.—Periostitis of lower end of femur, causing great swelling; abscess in joint. Discharged July 11th, 1866.

CASE 53.—Richard P—, æt. 15. Date of operation, August 30th, 1866.

Remarks.—Old abscess, dislocation and ankylosis of knee; wound affected with phagedæna October 1st. Discharged March 11th, 1867: wound almost healed; got about well with the assistance of crutches.

CASE 54.—Edward K—, æt. 7. Date of operation, March 14th, 1867.

Remarks.—Strumous abscess in knee-joint; immediate relief of pain by operation; no constitutional disturbance, and very little local action followed operation. Sent to Margate May 16th. Re-admitted with very movable joint in 1868, when the soft fibrous tissues between the ends of the bone were removed by operation without producing any constitutional disturbance.

CASE 55.—William C—, æt. 21. Date of operation, April 4th, 1867.

Remarks.—Strumous disease of knee. Died April 24th. The extremities of the bones were found softened; the cancellous structure of the femur in a state of diffuse osteomyelitis. The femoral vein contained some broken down coagula, but the lining membrane was quite smooth. There were incipient secondary deposits in the right lung. The liver was fatty, the spleen pulpy, and the kidneys congested.

CASE 56.—Luther W—, æt. 4. Date of operation, May 15th, 1867.

Remarks.—Abscess in lower extremity of femur communicating with knee-joint. Discharged October 19th.

CASE 57.—Anthony B—, æt. 9. Date of operation, June 6th, 1867.

Remarks.—Strumous disease. Discharged October 2nd

1867, wound healed. Union firm; limb one and a quarter inch shorter than the opposite one.

CASE 58.—Stephen K—, æt. 12. Date of operation, December 14th, 1867.

Remarks.—Strumous disease; abscess of femur opening into knee-joint. The knee had been bent at an acute angle since he was two years of age. A letter from the boy's father says that at that time Professor Syme "said it would be far better to have it taken off." The limb had never been developed. Some years ago he had an accident and broke the femur, which was allowed to unite with the end over-lapping and at an angle. The wound made in the incision healed in great part by first intention. He was discharged January 17th, 1868. A small sequestrum of bone was removed from the anterior edge of the tibia in June, 1868. Both before and after this he could walk firmly and without assistance, by means of a peg attached to the bottom of a lace boot.

CASE 59.*—November 11th, 1857. William E—, æt. 9, of Tiverton. Under the care of Mr. Kempe, of Exeter.

Strumous disease of the knee-joint, arising from a blow some years since. His health was very much impaired, rendering some operation imperative. Although the ease was not the most suitable one for resection, the friends preferred its trial to amputation.

The joint was resected under chloroform. The articular surfaces of the femur and tibia, with the whole of the patella, were removed, although the latter bone was not implicated in the disease. No vessels required ligaturing. The boy was much exhausted by the operation and the effects of the chloroform. The H-incision was made.

No untoward symptoms followed; the healing process, however, was very slow; several sinuses formed, which had

* This case is referred to at p. 146 as Case 58.

to be freely opened. At the end of six weeks there was a tolerably firm union of the bone. The sinuses showing no disposition to heal, and his general health remaining bad, it was thought best to send him home on December 19th.

Mr. Kempe heard that ultimately the wounds healed, and his health was restored; but his knee became much contracted. (See woodcut, p. 146.)

CASE 60.—November 10th, 1862. W. H—, of Ipplepen, farm labourer, æt. 16. Under the care of Mr. Kempe.

Acute synovitis of right knee-joint with abscess in the popliteal region; his health was much reduced.

After an anxious consultation, amputation above the knee was advised, as a less shock to the constitution, which was much depressed. On placing the matter before him, he preferred resection of the joint. Excision of the knee-joint was performed.

This case went on most favourably from the first, although it was complicated with bed-sores, and a large abscess of the opposite thigh.

The resected knee was quite healed in five weeks, with firm union between the bones; he had, however, a tedious recovery from the bed-sores, &c. He left the hospital quite well, and has not since been heard of.

CASE 61.*—November 17th, 1860. Ellen B—, æt. 11, of Tiverton. Under the care of Mr. Kempe.

Serofulous disease of the knee-joint, of one year's duration, with the knee bent and fixed at a right angle; her general health was not much impaired. Resection of the joint by one semilunar incision was performed; the articular surfaces, with the patella, were removed; the limb was placed in a Salter's swing with Prie's splint.

This was a tedious case; several sinuses formed, and re-

* This case is referred to at p. 147 as Case 60.

mained open. The general health having been very much improved, she was made an out-patient, in May, 1861.

The last time Mr. Kempe saw this little patient she was in perfect health; the sinuses were all healed; the limb was quite straight, and union very firm, with very little shortening; and she could walk with very little lameness. (See woodeut, p. 147.)

CASE 62.—April 15th, 1851. Sarah R—, æt. 8, of Whitstone. Under the care of Mr. Kempe.

Serofulous disease of the right knee-joint, of three months' duration; she was a very puny and delicate child.

By a semilunar incision the joint was exposed; the articular surfaces of the femur and tibia (much diseased) were, with the patella, removed. The after treatment was conducted on general principles; and she was made an out-patient in July with several small sinuses not healed.

This case has been seen by Mr. Kempe several times since, and is in all respects favourable.

CASE 63.—August 21st, 1861. George C—, æt. 18, servant, of Newton Bushell. Under the care of Mr. Kempe.

Serofulous disease of the right knee-joint of two years' standing. The same case was trephined December 16th, 1859, and August 8th, 1860.

The joint was exposed by a semilunar incision, and the articular surfaces of the tibia and condyles were removed; both were much diseased, especially the inner condyle and corresponding surface of the tibia. There was very free bleeding from the bone after the operation, which it was somewhat difficult to restrain. The limb was put on a straight splint and treated in the usual way.

This case progressed most favourably without any drawback, and at the termination of the seventh week the wound was entirely healed, and the union was complete. He was discharged cured November 5th.

There was, however, considerable shortening of the limb, nearly three inches and a half; but with a high-heeled shoe he walked about the ward quite well, and with very little lameness.

CASE 64.—December 16th, 1861. W. W—, æt. 6, of Exeter. Under the care of Mr. Kempe.

Scrofulous disease of the knee-joint, of many years' standing.

The limb was exposed by a semilunar incision, and the patella and articular ends of the bones were removed in the usual way.

For a few days after the operation he suffered much from vomiting and restlessness, which, however, gradually subsided; he made a slow recovery; but after three or four months left the hospital quite well, but with incomplete union of the bones. About twelve months after this he was again taken in for a contraction of the same knee, which under chloroform was straightened and put on a long splint, and eventually did well.

CASE 65.—June 21st, William H—, æt. 7, of Exeter. Under the care of Mr. Kempe.

Scrofulous disease of the left knee of six months' duration, producing great pain and emaciation.

A nearly straight incision across the joint was made, and the articular ends of the bones with the patella were removed; there was very little, if any, ulceration of the cartilage.

During the after treatment he was attacked with synovitis of the other knee, which pulled him down considerably; he was made an out-patient in September, much reduced in health and strength, but with the leg in good position and with fair union. The other knee was better.

This poor little boy never recovered his health. About ten months after leaving the hospital he suddenly became blind, and at the early part of 1864, died of tubercular meningitis.

CASE 66.—September 18th, 1863.—William A—, æt. 22, of Torquay, servant. Under the care of Mr. Kempe.

Scrofulous disease of the knee-joint, of three years' duration. He had been in one or two of the London hospitals, and many months in the Devon and Exeter Hospital, and, finding that he still got worse, was anxious to have the knee excised. The joint was exposed by an almost straight incision across it, and the articular surfaces, which were much diseased, with the patella, were removed.

The after treatment was conducted in the usual way, and he made a very good recovery. He left the hospital in January following, with a well moulded leather splint.

He visited Exeter about two months since, when Mr. Kempe found that he could walk at the rate of three miles and a half an hour.

His general health, which had been much impaired, was perfect, and he expressed himself in very grateful terms for his recovery.

The lady who gave him his recommendation was so pleased, that she most liberally presented a donation of £25 to the hospital on the occasion.

CASE 67.—February 2nd, 1864.—Joseph H—, æt. 18, errand boy, Exeter. Under the care of Mr. Kempe.

Scrofulous disease of the left knee-joint, of eight months' duration.

He had been subject to the usual treatment; but, the pain increasing, and his health becoming much worse, he was anxious to have excision performed. The joint was exposed by a semilunar incision from one condyle to the other, and the articular surfaces of the femur and tibia, with the patella, were removed. The case went on favourably. At the end of two months the bones were firmly united, but the wound was not healed.

He was made an out-patient in May, and is still in attendance with a very small ulcer open, but with a very straight limb, and firm union.

There was considerable secondary bleeding after this operation, and it was found necessary to apply the actual cautery to arrest it.

It should have been stated that the end of the femur was found denuded of its investing membrane to some considerable extent, and there was some doubt whether, in consequence, this case would do well. A second slice of bone was removed, which of course further tended to shorten the limb, and which, from the termination of the case, I do not now believe to have been necessary.

CASE 68.—May 25th, 1854. Elizabeth J—, æt. 33, of Morchard Bishop. Under the care of Mr. Kempe.

Disease of the knee-joint, of four years' duration. The joint was exposed by a semilunar incision, and the articular surfaces, with the patella, all much diseased, were removed. This case progressed favourably, and a most useful limb was procured.

CASE 69.—June 1st, 1864.—William S—, æt. 9, Tiverton. Under the care of Mr. Kempe.

Scrofulous disease of the left knee-joint, of some years' duration.

He was much emaciated, and suffered intensely from pain in the joint, and was most anxious to have some operation performed; this was against the wish of his mother at first.

The joint was exposed by an almost straight incision, and the articular surfaces, with the patella, were removed. The after treatment was conducted in the usual way, and the case was progressing most favourably till the beginning of July,

when he was attacked with tubercular meningitis, and died on the 17th.

The union of the knee was very firm; the soft parts were much ulcerated.

The following list of cases, from 70 to 82 inclusive, were kindly sent me by Mr. Delagarde, having been under treatment in the Exeter Hospital from 1865 to 1868.

1865.

CASE 70.—February 4th. John P—, æt. 13. Strumous. No union at eighty-six days. Amputation. Recovery.

CASE 71.—February 16th. George W—, æt. 16. Strumous. Good union. Recovery.

CASE 72.—February 22nd. James W—, æt. 12. Strumous disease and contraction. Good union in fifty days.

CASE 73.—February 27th. Joseph H—, æt. 16. Strumous. Good union. Recovery.

CASE 74.—May 25th. Elizabeth T—, æt. 33. Strumous. Good union. Recovery.

1866.

CASE 75.—June 10th. William F—, æt. 45. Strumous. Good union. Recovery.

CASE 76.—July 16th. William L—, æt. 18. Strumous. Good union. Recovery.

CASE 77.—September 29th. Maria P—, æt. 46. Chronic synovitis. No union. Died of phthisis February 18th, 1867.

CASE 78.—November 3rd. Richard W—, æt. 7. Strumous. No union after three weeks. Amputation. Recovery.

1867.

CASE 79.—October 2nd. Mary Ann S—, æt. 24. Strumous. Good union in fifty days. Recovery.

CASE 80.—November 23rd. Anna W—, æt. 41. Strumous. No union in seventeen weeks. Amputation. Recovery.

1868.

CASE 81.—May 16th. Ellen C—, æt. 16. Strumous. Good union. Recovery.

CASE 82.—September 19th. Thomas A—, æt. 26. Strumous. Good union, making a good recovery.

N.B.—The term “strumous” in the above cases for the most part implies abscesses, ulcerated cartilages, and sinking health.

CASE 83.—South Devon Hospital. Emily P—, æt. 25, married, was admitted May 4th, 1858, with scrofulous disease of the right knee-joint; the disease was of seventeen years’ standing; it commenced with pain, followed in two years with swelling. She was attended by different medical men, and underwent a variety of treatment till July 17th, 1855, when she became an in-patient of the Truro Infirmary, and stayed there some time; no improvement taking place, in September, 1857, she went into King’s College Hospital, under Mr. Bowman, who twice applied the actual cautery, without relief. Mr. Bowman refused to resect, as there was not sufficient evidence of disease.

Excision was performed by Mr. Whipple, on June 2nd, 1858, by the H-incision; the McIntyre splint was used. The patient was discharged, having made a good recovery, September 10th, 1858.

CASE 84.—Samuel S—, æt. 28, sailor, admitted July 27th,

1859, under Mr. Fox, with rheumatic disease of the knee-joint.

Excision was performed on September 23rd, 1859, and he was discharged December 28th, 1859, with good recovery. No notes were taken.

CASE 85.—Richard P—, æt. 25, waiter, was admitted January 13th, 1864, under Mr. Whipple.

Excision was performed (date not stated) ; death occurred on February 15th, 1864. No notes.

CASE 86.—Eliza B—, æt. 25, dressmaker, was admitted January 25th, 1864, under Mr. Whipple.

Excision was performed February 17th, 1865. She was discharged, having made a good recovery, August 23rd, 1865.

CASE 87.—Harriet H—, æt. 32, servant, was admitted on August 2nd, 1865, under Mr. Whipple.

Excision was performed on December 1st, 1865. She remained under treatment at the time of the report.

CASE 88.—Martha A—, æt. 15, was admitted September 5th, 1860, under Mr. Square.

Excision was performed on March 13th, 1861. No notes. She died of phthisis, three to six months after discharge.

CASE 89.—Ann B—, æt. 29, tailoress, was admitted October 5th, 1859, under Mr. Square.

Excision was performed January 13th, 1860. She was discharged cured.

CASE 90.—February 18th, 1864. Mary Ann L—, æt. 16, admitted into the Royal Albert Hospital, under the care of Mr. Swain, with disease of right knee-joint.

History.—For five years she had suffered from disease of the right knee-joint. She was first seized with an inflammatory attack, which subsided under treatment. This, however, was followed in three months' time by a second attack, which confined her to her bed. This attack passed away in about a month, but left her a cripple, as her leg became contracted on the thigh. During the last three years she had suffered from repeated attacks of inflammation of the knee. For some time she had been an out-patient, and had taken cod-liver oil and steel, and had worn a gutta-pereha splint.

On admission she was seen to be a pale and strumous girl, of hysterical disposition. She had a cough of two months' duration. The right leg was flexed almost at right angles with the thigh; the toes only of this foot touching the ground. The right knee-joint was much enlarged, and very painful on slight pressure. There was considerable thickening of the joint, giving it a very round appearance. The external condyle of the femur was much enlarged; the patella was inclined to the outer side of the joint, and fixed to the external condyle. She had no motion in the joint. She suffered much pain on the slightest movement of the limb, and was very subject to painful startings of the limb at night. (See Fig. 21, p. 100.)

Her leg was put up in a McIntyre's splint, and swung in a Salter's cradle. Slight extension was made, but was obliged soon to be discontinued.

March 14th.—The inflammatory attack had subsided; leaving, however, the joint very painful. The patient suffered considerably from painful startings at night, and complained of pulsation in the joint. Scott's bandage was applied.

May 20th.—The knee had subsided into a more chronic state. The inflammation had gone, leaving the joint in much the same condition as on admission. It was still very painful on handling, and was in no way benefited by the treatment pursued. At a consultation to-day, it was thought proper to

adopt some operative means ; and excision was thought the best course to be adopted.

28th.—The patient being placed under the influence of chloroform, the leg was flexed on the thigh. Mr. Swain made a semilunar incision ; and, after dissecting back the flap and dividing the lateral ligaments, exposed the joint. The crucial ligaments were gone, no remains being left ; the articular cartilage was entirely detached from the head of the tibia, as well as from the articular portions of the condyles of the femur. Mr. Swain then removed an inch and one eighth from the femur, and half an inch of the tibia ; after which it was thought necessary, by reason of the diseased state of the bones, to remove a thin slice from both the tibia and the femur. The diseased bone remaining on the section was gouged out, leaving a cavity in each bone of about half the size of a walnut. The leg was then extended on a Price's excision splint, and the bones brought into apposition. One ligature and three sutures were applied. There was not much hæmorrhage. The limb was swung in a Salter's cradle.

29th.—She had rather a restless night, with much constitutional disturbance from the chloroform and shock. Skin cool ; pulse 128 ; tongue furred. She was ordered to have a draught of citrate of potash, with eight minims of solution of muriate of morphia, every three or four hours ; also soda water and brandy, beef-tea, and twelve ounces of wine daily.

June 1st.—She had had repeated rigors. Skin hot and dry ; pulse 120, weak ; tongue furred, dry ; bowels confined. Suppuration had commenced in the wound. A diffused blush covered the upper and inner part of the thigh, from pressure of the corner of the splint.* R Ammoniae carbon, gr. iii ; ætheris chlor. ℥x ; solut. morphiæ muriat. ℥xii ;

* The pain and blush were referable to an unfortunate galling of the splint in the upper part of the thigh.

aquæ ʒj. Fiat haustus 4tis horis sumendus. An evaporating lotion was ordered to be applied to the affected part.

2nd.—The patient had a restless night, the joint starting much. The limb was in good position. The sutures were removed.

3rd.—She passed a good night. Skin cool. The redness had almost subsided. She was more cheerful.

8th.—She was much improved; slept well, and had a fair appetite. Skin cool; pulse quiet. The wound was looking healthy. There was free suppuration of healthy pus. Strips of lint, wetted, were strapped around the knee; and a compress prevented the condyle from rotating outwards, and also the bagging of matter up the thigh. Two days ago, the only ligature came away. Lately, she had restless nights, with pain under the leg and in the knee. To-day, some swelling, hardness, and redness was observed up the thigh near the groin, on pressing which, a large collection of matter escaped through the wound. The matter bagged back nearly to the groin. The wound of the flaps had united, except at the margins, where there was a free escape of pus.

July 18th.—The leg to-day was put up in a plaster of Paris splint, and she was allowed to get up. Lately there had been a slight discharge from the wound, which had healed, except in two or three small openings.

28th.—She suffered much pain in her thigh. Mr. Swain accordingly removed the plaster of Paris splint, when he found much pus bagging up the thigh, and setting up some little constitutional disturbance. This was pressed out through sinuses, and the leg put up in the resection-splint.

September 2nd.—A large abscess was opened in the muscles of the inner side of the thigh. Much pus was evacuated, after which the thigh became very easy.

15th.—A long sinus led from the counter-opening made on the 2nd, to the sinus in the excised part. To-day Mr. Swain passed a drainage-tube down the sinus.

October 10th.—The sinus in the thigh remained open, and pretty free discharge came from it. The patient had had a bit of drainage-tube inserted; but this was obliged to be taken out, and a poultice applied. Matter constantly formed in the sinuses, and required the application of a poultice for a day or two; after which she got up on crutches. The sinus was now injected daily with a weak solution of sulphate of zinc.

November 19th.—The sinus still remained open. There was a fresh formation of pus in the middle third of the under surface of the thigh, which discharged itself through the sinus. Her general health was very good. The union of bone was osseous and firm. The shortening was three inches and a half. She was made an out-patient. (See Fig. 22, p. 100.)

April 25th, 1865.—She was walking through a paved court, when, owing to the thick-soled boot she was wearing at the time not fitting well, her ankle turned and she fell. On examination, it was found that her right femur was broken about three inches above the cicatrix left by the resection of the knee-joint. A long splint was applied.

July 6th.—She was discharged. The leg was very slightly, if at all, shorter than before it was broken. She could use it quite well. The sinuses about the knee and on the outer side of the thigh were still discharging slightly.

December, 1865.—The joint was perfectly sound and strong. She walked with a high heel, and got about capably. The shortening was four inches, some of which was no doubt due to the fracture.

CASE 91.—Henry H— was admitted under the care of Mr. Swain, with disease of the knee-joint, on June 16th, 1864.

History.—Five years ago, while playing on the ice, he fell and injured his knee. Apparently he recovered from this; but a fortnight afterwards, during a walk, he was seized with

pain and inability to move the limb. He was treated for a sprain but received no benefit. Two months afterwards, he was an out-patient, under Mr. Swain, at the Dispensary. At that period, the knee was as swollen and contracted as at the present time. He left off attending at the Dispensary about four years ago. He had had no medical treatment since. Abscesses formed in the joint about eighteen months before his admission, and discharged for nine months; since which period the sinuses healed. His father and mother are living. He had been a very healthy boy, and not subject to a cough.

On admission, he was a healthy looking boy, but of rather strumous aspect. The glands in the neck were slightly enlarged. He was in good condition; pulse 80, of fair strength, regular; skin and bowels acting well; no cough. The left leg and thigh were much wasted. The leg was flexed to its utmost extent upon the thigh; the hamstring tendons were contracted and tense. In the lower third of the thigh were the orifices of five sinuses—four on the outer and one on the inner side of the limb. The left knee-joint was greatly increased in size, and of an oval form. The internal condyle of the femur was considerably enlarged. The external condyle was also enlarged, but to a less extent. The patella was inclined to the outer side, and ankylosed to the external condyle. The head of the tibia did not appear to be enlarged to any appreciable extent. There was little or no pain, except on manipulation of the joint. There was a little antero-posterior motion, with rather free lateral movement of the joint, showing destruction of the ligaments.

July 2nd.—To-day, the child being put under the influence of chloroform, Mr. Swain proceeded to perform excision of the knee-joint. A semilunar incision was made across the front of the joint, and the flap resulting dissected back from the patella and the end of the femur. The lateral ligaments were divided; the bone was cleared for the saw, and

foreibly flexed. About one inch and a half of the articular surface was sawn off. A slice was then taken off *obliquely* from the tibia, about one inch in thickness. An abscess in the head of the tibia, opening into the joint, was gouged out. The cut surfaces were then approximated; the flap laid down; and the limb put up in a resection splint. There was no hæmorrhage of importance; and no arteries required ligature.

8 p.m.—During the afternoon, the child had been very restless and noisy. The effect of the chloroform had not passed off; and the sickness of the stomach prevented morphia draughts from being kept down. When seen he was easy, and dozed at intervals.

3rd.—He had a quiet night, sleeping at intervals until the morning. Skin cool; pulse 104, quiet. He suffered but little pain. The knee was not disturbed. He was upon a water pillow, the leg being put up on an excision-splint, and swung in a Salter's swing.

4th.—He slept well through the whole night. This morning he was quiet, and suffered but slight pain. Pulse 126; skin dry, warm; tongue furred, with enlarged papillæ; bowels open. The knee was dressed this morning; the outside bandages were saturated with blood. The wound appeared healthy; water dressings were ordered. Ten minims of solution of hydrochlorate of morphia were ordered.

7th.—Last night he was very feverish, and had a rigor. To-day he was quieter. Skin cooler; tongue very furred; bowels confined. He took an egg and wine for dinner. When the leg was dressed to-day, a large quantity of grumous pus was squeezed out.

11th.—He was much improved. Skin cool; pulse quiet. He slept well at night without a morphia draught. He had a fair appetite. The leg was in a good position. The flaps were healing by granulations, leaving an open large pouch at the outer corner of the wound for free escape of discharge.

The wound looked healthy; and the discharge was very free. The wound was dressed with myrrh lotion.

20th.—He slept at night without a draught. There was not much discharge from the wound, as a small sinus and opening in the popliteal space effectually drew away the discharge.

September 5th.—The excision-splint, having galled him, had been left off, and the leg put up in gutta-pereha splints. Two or three sinuses remained about the knee-joint; and a gall on inner side of the knee and one on the heel, from the pressure on the splint. He got up and was dressed; was in good spirits, and took his food well.

19th.—The patient was up and about on crutches. The wounds on the leg had not yet healed; but they did not inconvenience him, except when dressed. A gutta-pereha splint was to-day moulded to fit the whole limb.

October 10th.—Three wounds on the leg still remained unhealed. There was a sinus leading to the head of the tibia, from which a thick pus, and a few days previously a small bit of dead bone, came. There was firmer union between the bones. A slight tendency of the tibia to bow out was obviated by a straight splint on the outer side of the limb. A straight splint was applied also to the under surface of the thigh and leg. He walked about on crutches.

17th.—Dead bone could be detected in the tibia; a small spiculum came away to-day in the discharge.

November 19th.—All the wounds were healed, excepting the sinuses leading to dead bone around the knee-joint. The leg was in very good position. Union was becoming firmer. The shortening was two inches and three quarters. (See Figs. 28, 29, p. 129.)

CASE 92.—Rosina L—, æt. 42, a rather spare, sallow-complexioned woman, was admitted on the 26th May, 1868, with disease of the left knee. The patella was slightly movable. The tibia and fibula dislocated (partially) out-

wards and backwards, and the leg also rotated somewhat outwards. At that time she suffered a good deal of pain in the joint, and the limb was altogether useless.

When under twenty years of age she had acute rheumatism, which left her with a weak and troublesome joint, which always caused her to walk a little lame. She used the limb until eighteen months ago, when she fell in the street, sprained and struck the knee, and since that the limb has been useless; after the accident she was confined to bed for three days and had leeches applied; had no other treatment.

Since her admission she has had a weight of four pounds attached to the leg, with the effect of greatly easing the pain but without any effect on the shape of the joint.

On the 6th August, Mr. Bulteel had a consultation, when all the surgeons present recommended amputation, but this she would not permit; he consequently resolved to excise the joint.

This was done on the 8th August through a semilunar incision. Just above the external condyle a small abscess was cut into; some matter also escaped with the first incision.

About one inch and a quarter of the femur and three quarters of an inch of the tibia were removed, leaving perfectly healthy surfaces. The wound was closed with silver sutures and the limb placed on an excision-splint. Chloroform was very badly borne.

Nearly all the articular cartilages were gone. In the outer condyle of the femur and in the head of the tibia the bone was extensively diseased, several small sequestra being all but loose. The articular surface of the tibia on both sides of the spine was much diseased. Pulpy degeneration was going on in the synovial membrane. Ordered Morphine Acet. gr. $\frac{1}{3}$, by hypodermic injection.

9th.—Wound at inner side bled considerably all night. Slept for a short time after the injection. Delirious during the night. Pulse 108, feeble.

10th.—Had a better night, delirious again; pulse 112, feeble.

13th.—Leg easy, has slept better; wound looking quiet, very slight discharge.

15th.—Appeared better this morning; skin cool; pulse 96; tongue coated; takes nourishment well; wound not so offensive; splint applied to anterior aspect of femur.

20th.—Pulse 96; improving; no pain in leg; not much discharge.

28th.—Wound healing rapidly, not discharging so much; pulse 96.

September 14th.—Wound not quite healed. No sinuses. Health good.

22nd.—Splint removed and gutta pereha substituted.

October 10th.—Plaster of Paris splint adjusted.

17th.—Plaster of Paris removed, and leg put up in paste-board, gum, and chalk.

December 12th.—Union not yet formed. Leg put up with gutta-pereha splint. Gets up for a short time daily.

15th.—Leg about two inches short; union all but formed.

January 25th.—Splint of Hyde's felt adjusted, and thick solid boot put on; can walk about with the aid of a stick.

February 4th.—Can support her weight on the leg; union still yields a little.

March 1st.—Slight movement in antero-posterior direction; none in lateral; can rest her whole weight on the leg, and move about with the aid of a stick.

CASE 93.—Jane M—, æt. 19, a servant, florid complexion, strumous-looking; function of viscera discharged naturally; pulse 96, small; appetite good; gaining flesh. The synovial cavity of right knee distended with fluid, with red patches on the surface; suffers but little pain. Has an abscess over the posterior part of the right crest of the ilium discharging about one drachm of pus daily.

About four months ago she felt the right knee stiff and occasionally painful. She received no hurt, sprain or injury that she is aware of. About two months previous to admission, startings of the limb were superadded to the stiffness and pain. She has four brothers and two sisters, all living. No history of consumption or scrofula in her family. On 28th November Mr. Bulteel excised the joint.

The fluid, about five to six ounces, was serous pus. As much as possible of the synovial membrane was removed. The operation lasted about forty-minutes.

29th.—Much chloroform depression and sickness. Passed a fair night. Leg not very painful. Skin rather hot; tongue clean, takes but little nourishment; pulse 132, easily compressed. But little hæmorrhage. Ordered milk Oj, wine ʒiv , brandy ʒij .

30th.—Had a fair night; pulse 132; knee looking quiet, not painful, taking but little nourishment.

December 1st.—Quiet night; looking better; pulse 120; tongue slightly furred. Bowels not open since operation. Abscess in back discharging but little, knee quiet, no discharge. Ordered ale Oj.

2nd.—Slept fairly; pulse 120; bowels acted this morning; appetite indifferent. Does not complain of pain. Wound dressed, discharging a moderate quantity of blood-stained pus.

15th.—Pulse 96; bowels confined. Wound discharging rather profusely. Leg removed from splint and clean pads put on.

25th.—Pulse 120. Skin rather hot. Tongue slightly furred. Appetite slightly improved, knee discharging freely, still much swollen. Right leg œdematous.

January 2nd.—Splint removed and pads changed. Counter-opening made in flap and piece of silk passed through carbolic acid lotion applied, and the whole knee firmly bandaged.

8th.—Tongue clean. Appetite much improved. Drainage tube carried down to the inner side of the knee, about one inch and a half above the wound. Wound looking much better, still discharging freely.

27th.—Splints removed and clean pads fitted. Discharge plentiful. Sinus over situation of patella still open. Not losing ground.

February 8th.—Fresh pads applied. Sinus opened up from inner opening. Discharging freely.

10th.—Leg looking much better, not so much discharge.

April 2nd.—Opening formed in the popliteal space, still discharging. Wound and sinus over the lower end of femur still unhealed, some union (fibrous) at inner side.

20th.—Leg still 'a good deal swollen. Wound not yet closed. In the popliteal space there is a triangular opening, which discharges a considerable quantity of pus.

30th.—Back splint removed, and two side splints made of light galvanised iron, with brackets at the knee put on, and encrusted with plaster of Paris.

May 16th.—Gets up every day. Knee much improved in shape.

25th.—Opening in popliteal space still large, discharging about four ounces of serous pus per diem. Sinus running downwards on the inner side of the leg. Is not feeling well. Has diarrhœa.

27th.—Pulse 108, feeble; diarrhœa still continues; is losing ground rapidly. Urine albuminous, acid. Consultation held and determination to amputate.

29th.—Amputation performed through the lower part of the femur by skin flaps, the anterior being much longer than usual. Very little blood was lost. On examining the limb, the bones at the knee were found to be in good apposition, but very little union had taken place, and that little was of a soft fibrous nature. There was no pus between the bones,

which appeared to be healthy. The tissues of the limb were generally very pale and œdematous.

30th.—Has been very sick since the operation; looking pale; pulse 144, feeble; Respiration rather hurried; tongue slightly furred; bowels moved once; taking but little nourishment. Has but little pain in the stump. No hæmorrhage. Ordered Ammon. Carb. gr. v, Æth. Chlor. ℥xx.

June 2nd.—Taking nourishment better, not so much vomiting. Stump much swollen, discharging freely.

3rd.—Pulse 120; tongue still furred, slightly moist. Has been vomiting frequently. Bowels very much relaxed, with much pain. Stump discharging freely, very offensive. Redness at upper part of thigh extending. All the sutures removed. Ordered Cupri Sulph. gr. $\frac{1}{4}$, Tr. Opii ℥x, Tr. Cardam. ℥lx, 2dis horis.

4th.—Erysipelas not spreading; stump much swollen; discharge very offensive.

6th.—Pulse 108; vomits everything taken; stump healthier; erysipelas subsiding; does not complain of pain.

14th.—During the last week she has been losing ground. Bowels always relaxed from three to six times a day. Taking but little nourishment; pulse 108 to 120, very feeble; stump looking healthy.*

CASE 94.—John V—, æt. 15, compound comminuted fracture and laceration of right leg, with lacerated wound of left knee-joint. Medical officer, Mr. Laity. Was admitted into the hospital July 27th at midnight. While attending a pumping engine his foot caught by the spoke of a wheel, his right leg was caught in and jammed between the wheel and a disk. The engine was at once stopped, but two hours elapsed before he could be extricated. He was brought into the hospital at 2 a.m. On admission collapsed, and in extreme pain. Pulse small, feeble; pale, cold extremities.

* This patient has since died.

The left leg was terribly hurt. The integument was stripped off from the head of the tibia to the foot entirely, excepting some of the skin of the calf of the leg. The cellular tissue covering the muscles was torn and bruised, surfaces of the muscles rough from attrition and covered with oil, the tibia was exposed; an oblique fracture ran across the bone about three inches below the head, and another fracture about the centre of the shaft, separating a large portion of bone about four inches in length, which was detached and only hanging by periosteum; a third fracture separated the lower epiphysis of this bone from its shaft. The larger arteries and nerves escaped injury, but there had been rather free hæmorrhage. There was a lacerated wound, which divided the tendon of the rectus and vasti muscles of the left leg, and had laid open and exposed the knee-joint. This wound was semicircular, and formed a flap including all the muscles and integuments of anterior surface of lower third of the thigh.

The medical staff were summoned, and chloroform being administered, Mr. Laity amputated the right leg through the knee-joint. Cutting through the ligamentum patellæ, the knife entered the joint, and then cut out by making a posterior flap from the muscles and integument of the calf of the leg. The articular surfaces of the femur and the patella were not removed. Several vessels were ligatured, the flaps were brought together by silver sutures.

The boy was in too precarious a condition to take into consideration any operation for the left leg, so this leg was put up in a McIntyre, the flap was laid down over the knee, and six wire sutures put in.

July 27th.—Very feverish; pulse 140; skin hot; tongue furred; not moist.

28th.—Pulse 102, very feeble; much depressed. Is only partially sensible. No hæmorrhage from stump.

August 3rd.—The left thigh was amputated about the junction of the upper, with the middle third by lateral flaps

which were brought together by four or five silver sutures and strapping.

4th.—Passed a restless night. Has vomited several times since the operation. Bowels not acting. No inclination to take nourishment. Pulse 120, soft and feeble. Had two enemata, both returning about an hour after.

5th.—Was very restless during the night, did not sleep, skin cool. Respiration shallow. Pulse 108, feeble. Discharge from the right stump more healthy, some granulation appearing. Sutures all removed. Left stump rather tense, discharging a moderate quantity of offensive serous pus.

6th.—Had a much quieter night, slept for an hour and a half this morning, frequently dozing. Has taken about four ounces of brandy, Oij of milk, and a few mouthfuls of mutton since the morning. Respiration laboured, 45 per minute. Pulse 120.

7th.—Tolerably quiet during the night, slept for two hours this morning; has consumed a fair quantity of brandy during the night, and has had an enema of beef tea.

8th.—Had a restless night. Skin warm and moist; respiration laboured. Tongue rather dryer. Vomited this morning after breakfast. Bowels acted once since last note. Pulse 144, feeble. Urine passed voluntarily, good colour, plentiful. Right stump granulating more extensively. Left sutures cutting through, therefore removed; discharge free, still dirty and ill-conditioned; had a small quantity of sole for dinner, and has taken a good quantity of milk. Died at 5.10 p.m.

CASE 95.—John H—, æt. 18, was admitted, under the care of the author, with disease of the knee-joint on July 7th, 1864.

History.—He stated that he injured his right leg about five years ago. The only immediate effect of this was to cause swelling of the joint, which never subsided. At that time it

was not very painful. For three years this swelling caused no great inconvenience, and he performed his ordinary avocations, as a miner. At the end of that time the joint became stiff and painful. He kept on working, however, until ten weeks ago. The pain and inability to move the limb then compelled him to give over working. He had been healthy, and not subject to cough.

On admission he was seen to be a healthy, but slightly-formed lad. Pulse 90, quiet; skin cool; bowels acting. The right leg was extended almost to its full extent, and slightly wasted. The lower leg was longer than usual for one of his height. The knee-joint was much enlarged, of oval shape, much bulged on the inner side, and very tender on manipulation. There was some effusion into the joint. The patella was movable, and in its normal position. The head of the tibia was considerably enlarged. The external condyle of the femur was enlarged; the internal condyle was likewise enlarged, but to a less extent. He had little or no power of flexing the joint. There was rather free lateral movement.

18th.—He had an attack of acute inflammation of the knee, with much pain and swelling, and slept badly; skin hot; pulse 100; tongue furred. The knee was acutely painful on the slightest movement. The leg had been extended on a McIntyre's splint and swung in a Salter's swing. Poppy fomentations were ordered to be constantly employed; and three grains of Dover's powder to be given every four hours.

27th.—Blisters had been applied, and had risen well: and fresh ones were ordered. The joint was less swollen. The pain had abated. He slept well, and had a good appetite.

September 5th.—The patient continued under treatment since the last note. Blisters and iodine were applied; and perfect rest maintained. The knee continued as much swollen as ever, with considerable tenderness over the joint.

He had lost his health lately ; was very thin and weak. On the 4th, a gutta percha splint was applied to the leg ; and he was allowed to get up and walk about the ward. He was ordered to take cod-liver oil.

21st.—His chest was examined. There was dulness over the right apex ; the vocal resonance was increased. There was diminished respiration, and slightly prolonged expiration. He had an occasional hacking cough. The boy walked about on crutches.

October 8th.—Since the last note he had recovered strength ; he was tolerably strong now, and walked upon crutches. He went out to-day to recruit his health ; and was made an out-patient.

He was re-admitted under the author on March 8th, 1865. He perspired at night, but not profusely. Pulse 90, of good volume, compressible ; tongue clean and moist ; appetite not very good ; bowels rather relaxed ; urine natural ; no cough or expectoration. Breathing was coarse beneath both clavicles, with prolonged expiration.

The right knee was enlarged, chiefly at the inner condyle of the femur ; it was one inch larger round than the left. The tibia and fibula were rotated outwards and fixed in a semiflexed position. The patella was fixed to the end of the femur. The circumference of the right thigh was ten and a half inches ; of the left thirteen and a half inches ; of the right calf nine and a half inches ; of the left twelve inches. The right foot was red and brawny. While standing on the left leg, the right heel was about five inches from the ground.

March 11th.—The author opened the joint with the view of excising the articular ends of the bones ; but found them so far diseased that he thought it advisable to amputate in the lower third of the thigh, which he did by antero-posterior flaps. The wound was brought together by strapping without sutures, and dressed with wet lint. A third of a grain of acetate of morphia was given.

12th.—He slept some hours during the night; looked pale. Skin warm and dry; respiration natural; pulse 100, compressible; tongue clean and moist. He had no appetite; was thirsty; vomited several times since the operation. He complained of much pain across the epigastrium. The wound was not dressed. There had been slight oozing of blood ever since the operation.

14th.—He passed an indifferent night, but looked rather better. Skin not so hot, still dry; cough easier; pulse 120, rather jerky, soft; tongue thickly furred, moist. He took but little nourishment; could not take the wine. He vomited after taking the medicine. Bowels confined. The stump was not yet suppurating; still oozing. The wine and medicine were omitted.

16th.—He had a good night. Skin warm and moist; pulse 96, soft; tongue slightly furred. He took his nourishment better; but vomited after the dinner. The stump was discharging a small quantity of bloody serum; no pus. He complained of pain in it. He was ordered two pints of ale.

18th.—He slept well; and looked much better. Skin cool and moist; pulse 108, soft; appetite improving; no vomiting. The bowels were well relieved by a common enema. He complained of a twitching in the stump, which discharged a moderate quantity of bloody pus.

19th.—He slept well. Pulse 100, soft; bowels acting; tongue clean and moist. The stump was granulating in parts; there was not so much blood with the discharge. He complained of twitching.

21st.—He had a fair night. Skin warm and dry; pulse 100, rather feeble; tongue slightly coated on the dorsum, moist. He took his food better; had no vomiting. The stump was granulating and discharging tolerably healthy pus.

24th.—He was looking better; slept well. Skin cool and

moist. He had a slight cough, and expectorated a little nauseous mucus. Pulse 96, rather feeble; tongue slightly furred; appetite pretty good; no vomiting. The bowels had acted once. Two ligatures came away. The patient had pain, referred to his foot.

25th.—Two more ligatures came away. The wound was granulating well.

April 5th.—He ate and slept well; and his general condition was improving. The stump was contracting well.

15th.—The general health was much improved, and he was gaining flesh. The stump was almost healed. He had been out of doors each fine day this week.

June 20th.—He left the hospital with his stump quite healed, and his general health much improved.

CASE 96.—Margaret B—, æt. 6, admitted into the Royal Albert Hospital, under the care of the author, August 4th, 1864, with disease of the knee-joint. One year and a half previously, the knee-joint began to enlarge. In four or five months afterwards, an abscess formed and burst, leaving sinuses. Since then, wounds in various parts of the body had kept up a continuous drain upon her system.

On admission, she was seen to be a pale, badly nourished, strumous child, in a very cachectic state. There were two open wounds over the left elbow-joint. The bones of the third finger of the left hand were necrosed and destroyed. There was a wound on the back of the left hand, and four wounds on the right leg. The left leg was permanently bent upon the thigh at right angles; the knee-joint was greatly enlarged; and above and below were sinuses leading down to bare bone. On the left leg were several wounds.

October 8th.—Since admission, the child had improved in health. The third finger of the left hand had been amputated, and most of the wounds had healed. The left knee

remained in the same condition. At a consultation it was determined to amputate the left thigh. Accordingly, to-day, the child being under the influence of chloroform, the author amputated the left thigh in the lower third by antero-posterior flaps. Several vessels were ligatured. Five silver wire sutures were inserted. The stump was dressed with wet lint only.

16th.—Since the operation, the patient had been very quiet. A morphia draught was given. She slept at snatches during the night. Her expression was natural; skin cool; pulse 160, feeble; tongue moist, slightly furred, with enlarged papillæ. Last evening she was sick after the chloroform, and had no appetite. She took some bread and butter and tea for breakfast this morning. There was no oozing from the stump. The dressing was not removed to-day.

17th.—She slept very fairly. Face flushed; skin hot; pulse 130, very feeble; tongue furred, with enlarged papillæ, red at the edges. The patient slept at intervals, and started up screaming. The bowels had not been open since the operation. There was a discharge of offensive sero-sanguineous matter from the wound. The thigh and left labium were much swollen, red, and very painful. She was ordered to have sponges, wrung out of hot water, applied to the thigh; and water dressing, soaked in Condyl's solution, to the stump. She took three ounces of wine, milk, and strong beef-tea much as she could make use of; and was ordered—*R Ammonia sesquicarb. gr. j; æther. chlor. ℥v; tinct. cinchonæ comp. ʒss. M. Fiat haustus 4tis horis sumendus.*

18th.—She slept at intervals during the night. Expression anxious; face pallid; skin hot; pulse irregular, so quick and feeble as to render it hard to count accurately; bowels not acting; tongue furred. She took her wine and beef-tea. The edges of the wound were distended; there was free and very offensive sero-sanguineous discharge. The thigh was much swollen, but less so than the previous day;

the redness had subsided. She was ordered to have a senna draught immediately.

20th.—She slept well, without a morphia draught. Skin cool; pulse 130, very feeble; bowels acting. There was less swelling of the thigh.

21st.—The silver wire sutures, owing to tension of the flaps, were cutting through; accordingly they were removed to-day. The flaps separated in consequence, and a large quantity of offensive purulent discharge made its escape.

23rd.—The expression was more natural. She slept well. Skin cool; pulse 140; tongue moist, slightly furred; bowels acting. The outer third of the flap was opened abroad, and suppurating freely. The inner third of the extent of the wound was uniting. The wound was looking more healthy. The suppuration was healthier. She took her wine, milk, and beef-tea; and, in addition, had two eggs a day.

26th.—She slept much; skin very perspiring; face rather pallid; pulse 120, stronger; tongue moist, clean. The stump was granulating very healthily; the discharge was less, and more healthy. She took her food and wine.

31st.—Her expression was natural; skin cool; bowels acting. The wound was closing in; the granulations were healthy; and the discharge was greatly decreased. Two ligatures had come away. Pulse 120; she was better in health.

November 9th.—The wound had healed, except in the track of the ligature of the femoral artery, which still remains open. The remaining ligatures had escaped. She was much improved in health, and took a drachm of syrup of superphosphate of iron three times a day.

19th.—The ligature had not yet escaped. There was some considerable swelling and hardness, with great tenderness of the glands in the groin—possibly from irritation of the ligature.

20th.—The last ligature had made its escape.

26th.—An abscess had formed and burst in the thigh, at the upper margin of the wound. There was free discharge from the openings. The glands in and below the groin were enlarged and painful. A poultice was applied to the wound and over the hardness in the groin. She was taking bark and ammonia again.

30th.—The abscess had healed up, and the sinus was healed.

This patient quite recovered from the effects of the operation, but returning to a wretched home she soon fell back, and died some few months after her discharge from hospital.

CASE 97.—Wm. H—, miner, admitted under the care of the author, September 30th, 1865, with disease of the right knee-joint, and phthisis.

History.—He was a miner by occupation. His habits were regular and temperate; he was married. His knee began to swell and become painful about three years ago, after he had been working in water. For two years he had occasional pain and swelling. During the last twelve months, the joint had been gradually enlarging, and had been more painful, occasionally preventing his working.

He had been laid up for the last six weeks only. His father died of phthisis about twenty years ago, aged 41; his mother was still alive. He had several brothers and sisters, all healthy. He was a sparely nourished man, of fair complexion. He looked pale; skin warm and moist. He perspired very much at night. Respirations natural; occasional slight dry cough; pulse 110, rather feeble; tongue slightly coated with a white fur—moist; appetite bad. He had vomited several times lately. No thirst; bowels confined; urine natural. His sleep was much disturbed, but he had pain and startings in the left knee-joint at night. The knee was swollen principally over the internal condyle; circum-

ference, right, $16\frac{1}{2}$ inches; left, $13\frac{1}{2}$ inches; right thigh, 11 inches; left, 13 inches. The patella was slightly movable; no tenderness, except at a spot behind the internal condyle, which he could not bear touched. The knee was slightly flexed; leg œdematous.

Sept. 30th.—There was dulness on percussion beneath the right clavicle, with pectoriloquy, prolonged expiration (coarse), and scanty moist crepitation. The heart-sound was heard abnormally loud over the right side. Puerile respiration was heard over the left lung. He was ordered a pint of porter, and—℞ Potassii iodidi gr. v.; spirit. ammoniæ co. ʒss; tinct. cinchonæ ʒj; aquæ ʒj. M. Fiat haustus ter die sumendus. A blister, an inch and a half by three, was applied to the knee; and twenty minims of solution of acetate of morphia were given at night.

Oct. 3rd.—He was ordered a pint of milk, and four ounces of wine. ℞ Æther. chlo. ʒx; infus. gentianæ ʒj. M. Fiat haustus ter die sumendus.

13th.—He was ordered an ounce of cod-liver oil three times a day, and one egg.

21st.—He slept well; perspired much less. Respiration was easy; cough slight; no expectoration; pulse 108, of moderate volume, compressible; tongue almost clean and moist; appetite much improved; bowels regular. The painful startings at night were much less frequent.

28th.—The author amputated by anterior and posterior flaps immediately above the knee-joint. The wound was brought together by silver sutures, and the stump wrapped in wet lint. The joint was found to be full of pus and *débris*. The cartilages covering the external articular surface of the femur and the opposite surface of the tibia had disappeared. The internal surface of the femur was ulcerated, and the cartilage detached. The internal surface of the tibia was covered by cartilage, much thinned and separated at its edges. The crucial ligaments were present,

but much softened. Only a vestige of the semilunar cartilages could be found. The cartilage on the patella was surrounded by a line of ulceration. The synovial membrane was in a state of pulpy degeneration.

29th.—He passed a good night, but looked pale. Skin hot and dry; respiration natural. The cough troubled but little. Pulse 132, easily compressed. Tongue coated with a dirty white fur on its dorsum, red at its tip, moist. He was slightly sick after the chloroform, and vomited once during the night. He took nourishment fairly; was thirsty. Bowels confined; urine rather scanty. He had little or no pain or twitchings.

Nov. 1st.—He slept fairly; looked pale. Skin cooler; cough troublesome; pulse 108, rather jerky; tongue still furred; appetite moderate. He vomited twice last evening; not much nausea. He was thirsty. Bowels open; urine plentiful, clear. The wound was suppurating; not painful.

3rd.—He did not sleep much. Skin warm, moist. He perspired freely at night. Cough easier; pulse 108; tongue clean, redder. He took but little nourishment yesterday. No vomiting; thirst slight; bowels confined. The wound was discharging freely; looking rather red around the sutures.

5th.—Sleep was almost prevented by cough; there was very little expectoration. Skin dry; pupils dilated; pulse 108, of moderate volume; tongue cleaner, rather dry and red; appetite bad; bowels open. The stump was discharging a moderate quantity of healthy pus. It was dressed with a weak solution of Condyl's fluid. Three sutures were removed.

13th.—The patient's nights were much disturbed by a very troublesome cough, with very little expectoration. Skin hot and moist; he perspired very profusely during sleep. Pulse 108, easily compressed; tongue clean, rather red, and moist; appetite very bad. He took his wine.

Slight thirst; bowels regular. He complained of twitchings in the stump. The wound was contracting. About an ounce and a half of pus came away from one of the apertures left by the sutures during the dressing.

15th.—He was ordered to have two eggs, and eight ounces of wine; to have a draehm of tincture of *einehona* added to the mixture; and to take twenty minims of solution of hydrochlorate of morphia.

17th.—He slept better, but perspired very much. Pulse 108, rather jerky; cough not so troublesome; tongue clean and moist; appetite improving; bowels acting regularly. The wound was contracting, and discharged a moderate quantity of creamy pus; it was rather more painful. He was ordered a pint of Bass's ale.

23rd.—His general condition was unaltered. The stump was looking full. About an ounce of pus passed out of the existing opening; it was evidently burrowing upwards between the muscles. Two ligatures still remained firmly attached.

28th.—He looked better; slept fairly. Perspiration was less profuse, and the cough easier; pulse 108, jerky; tongue clean; appetite pretty good; bowels rather costive. The wound was almost healed; it discharged a moderate quantity of pus from the ligature-openings.

Dec. 2nd.—The patient's sleep was sometimes disturbed by cough, with slight expectoration. Pulse 108, rather feeble; tongue clean; appetite fair; bowels rather confined. He was not losing flesh. The stump was still discharging a moderate quantity of pus. The two remaining ligatures came away. He was progressing favorably, and ultimately recovered.

CASE 98.—E. B—, æt. 50, labourer, admitted into the Taunton and Somerset Hospital, June 11th, 1864, under Mr. Liddon, with disease of the left knee-joint, of six years'

duration, and a discharging sinus over the centre of the sternum connected with disease of that bone. There was no history of syphilis. The knee was slightly flexed, swollen, with an evident thickening of the synovial structures, very tender to the touch, and excessively painful at night. His general health was bad; tongue furred; occasional diarrhœa, and loss of appetite, but no cough.

The treatment consisted in keeping the joint at rest by a splint, etc., and supporting the strength by tonics and liberal diet. Instead of improving, the patient lost flesh gradually; suppuration took place in the joint, and sinuses formed.

On October 8th, 1865, the patient having somewhat rallied, amputation was performed about the middle of the thigh, as the bone was thickened in the lower third. He survived the operation for a few days, and then died with congestion of the lungs.

On his admission, Mr. Liddon thought that, if his general health could be improved, it would be a fit case for excision. Amputation was, however, resorted to, as affording the best chance, in not calling so much upon the restorative powers at his age, and in his weakened condition from the extent of disease in the femur.

CASE 99.—Thomas B—, æt. 18.

A tall, pale lad was admitted into the Royal Albert Hospital, under the care of the author, from St. Germans, on the 17th December, 1868, having the upper and inner part of his right leg much swollen. On the inner side of his right knee there was an opening from which a small quantity of serous pus was escaping. There was a good deal of swelling about the lower part of his thigh, and on the outer side of the knee distinct fluctuation could be obtained. Pulse 108; bowels regular; skin warm and moist; appetite good. Does not suffer, unless when moved.

History.—Five weeks before his admission he was suddenly

attacked with acute pain in the inner side of the thigh; swelling rapidly occurred, and about a fortnight after an opening was made, and a large quantity of pus evacuated. After his admission the swelling began to extend down the calf; another incision was made, and about six ounces of healthy pus made its escape; a drainage tube was placed in the opening, and firm pressure made on the track of the abscess. Twice a grooved needle has been inserted into the outer side of the joint, but only a little bloody serum escaped. On Dec. 24th the swelling began to increase upwards from the knee, and the part became excessively tender, though not very painful. A puncture was made into this on the 25th instant, but no matter could be found.

On 27th Mr. Swain thought the condition of his leg was so much worse, the femoral glands also being inflamed, that he determined to call a consultation, which was accordingly held on the 28th instant.

During the night a large quantity of pus had escaped through the first opening, and the state of the limb was so much improved that any operative proceeding was considered uncalled for. Ordered—Hst. Cinchonæ Acid., 4tis horis; Pil. Ipecac. co. gr. x at bedtime, No. 1 diet; porter Oj; wine $\bar{3}$ vj.

31st.—General condition unaltered; appetite good. Pus collecting above the inner condyle of femur, a counter opening was therefore made from within by the trocar for puncturing the bladder, and a piece of drainage tube put in. Opening in calf closing; knee still very tender.

Jan. 3rd.—Leg looking quieter; not much discharge through drainage tube; general condition improving.

5th.—Swelling over the lower end of femur not so tense; discharge less.

8th.—Pus again collecting below the opening in the calf, from which a probe was passed downwards for about three inches, a counter opening made, and a drainage tube passed through. General condition much improved.

11th.—Had a restless night, with much pain in the knee. Tongue clean; bowels regular; appetite good; pulse 108. Not much discharge.

13th.—But little pus passing through the tubes; swelling extending up the thigh. Pulse 108; tongue clean; bowels regular; appetite fair.

16th.—Mr. Swain amputated through the thigh by Teale's method of rectangular flaps. Several vessels required ligation; the wound was closed with silk sutures; no chloroform sickness; not much shock. The synovial membrane was found to be in a state of pulpy degeneration. The articular cartilage covering the external condyle of the femur and the external articular surface of the tibia was ulcerated. On section the bones presented a uniform dirty pink colour. There was a large sinus passing from the abscess in the thigh downwards through the popliteal space close to the bone, which was denuded immediately behind the joint, to the abscess in the calf.

17th.—About seven hours after the operation, while he was using the bed pan, hæmorrhage to the extent of six ounces occurred from the stump. It was easily stopped by pressure on the femoral. Passed a fair night; pulse 108; appetite fair.

18th.—Had a good night; pulse 96. Stump a good deal swollen. Ordered—*Lotio evaporans*.

19th.—General condition good. Pulse 120; bowels not acted since 16th; appetite good; tongue all but clean. Stump still swollen; discharging a little pus; not painful.

20th.—Had a very good night. Pulse 108; bowels moved once; takes food well. Stump not so much swollen; discharging freely, rather offensive; small line of slough forming at outer side; several sutures removed.

21st.—Wound opening a little; discharging freely; less swollen.

22nd.—Three ligatures came away. Stump looking quiet. Appetite good; pulse 108, fair volume.

23rd.—Wound opening more. One ligature came away. Two more sutures being cut through, were removed. Appetite very good; pulse 108.

25th.—Doing very well. Not much discharge. Only three ligatures remain. Swelling quite subsided.

27th.—Wound healing. Two ligatures only remain. General condition very good.

29th.—Last ligature came away. Wound looking well.

Feb. 4th.—Wound healing pretty rapidly. Dressed with Lotio rubra.

7th.—Stump still healing well. Has not been feeling quite so well for last day or two; complaining of pains in the bowels and loss of appetite; urine very scanty.

11th.—Is gaining flesh. Stump healing rapidly. Out of bed to-day.

14th.—Nearly well. Up every day.

Discharged March 17th, 1869. Stump quite sound.

CASE 100.—*Corneitis; effusion into both knee-joints.*—Mary Ann W—, æt. 19, was admitted into the Royal Albert Hospital, under the care of the author, on Sept. 5th, 1863, with interstitial corneitis in both eyes. She had also peg-topped teeth. She had suffered from inflammation of the eyes for some years, and her sight was much impaired. She was ordered the Syrup of the iodide of iron and cod-liver oil.

On Sept. 23rd rapid effusion took place in each knee-joint, unattended with pain. The joints were blistered, and afterwards painted with iodine. She was ordered to take the Liq. Hyd. Biehlo. with Cinchona.

Blisters were applied again on the 29th and Oct. 3rd. Her sight improved considerably, but the effusion in the knee-joints was not altogether removed.

On Dec. 12th the joints were strapped and she was discharged much relieved.

CASE 101.—*Painful Stump*.—M. H—, æt. 30, admitted into the Charing Cross Hospital Nov. 30th, 1858, under the care of Mr. Hancock. Had disease of the left knee-joint at ten years of age. At fourteen the knee being much swollen and very painful, was punctured, and a considerable quantity of blood escaped, but no matter. At sixteen the catamenia appeared; they left her for two years, and then returned, but with irregularity. At seventeen years of age she fell, and so much injured her knee that she went into the Royal Free Hospital, where the leg was amputated. The stump healed rapidly; but accidentally falling upon the floor, she hurt the stump so much that it reopened, and the bone protruded through the wound, which would not heal. The pain was intense, and subsequently about two inches of bone were removed. After this she recovered, and remained well until about four years ago, when she felt as if the limb was entire—as if the blood were rushing to every part below the amputation, accompanied with great pain in the nerves. The pain gradually increased, and ten weeks since it became more violent than ever, and was almost unbearable; so much so, indeed, that she begged me to amputate the leg higher up.

Upon her admission, on the 30th of November, I carefully examined the stump, and found that the cicatrix at one point was tied down, as it were, to the end of the bone by a dense band about three quarters of an inch long, and that any pressure upon this point increased her sufferings to a great degree. The end of the nerve, enlarged into a considerable bulb, could easily be distinguished, attached by this band to the bone also, thus accounting for the pain which she experienced in the course of the nerve. I had upon previous occasions, in other cases, dissected out these bulbs, but with so little success that I was convinced that the sufferings

could not depend so much upon them as was usually supposed, whilst the result of the ease I have just related led me to expect that if the cicatrix was released from the bone, so as to permit free movement, the patient would be relieved from pain without another amputation. Accordingly, on the 11th December the cicatrix was separated from the bone by a subcutaneous incision, the connecting medium being so dense as to resemble cartilage. The soft parts were moved gently over the bone for a short time every day until the wound was healed and all trace of tenderness had ceased. The stump, which had previously been puckered and baggy, became round and plump, the pain entirely ceased, and she left the hospital, cured, on the 14th January, 1859.

CASE 102.—*Specimens showing the process of repair after resection of the knee-joint.*—These bones (that is, the lower end of femur and the upper ends of the bones of the leg) were removed by amputation from a boy, æt. 13, who had undergone resection of the knee-joint eleven months previously.

The following is the history of his case :

T. J—, æt. 12, came into the Children's Hospital in January, 1867. He had suffered from disease of the right knee-joint for eight months ; his joint was extremely painful and swollen, and his constitutional symptoms were severe. A quantity of pus was let out of the joint with but temporary relief.

As the boy was losing ground, the joint was excised. The patella was removed, and a thin slice both of the femur and tibia. At the time of the operation a large abscess was met with in front of the femur, and another behind the tibia ; drainage tubes were passed through these abscesses. An abscess was found in the head of the tibia ; this was gouged out, and the compact tissue of the bone was cut away opposite to the cavity, so as to give exit to the discharge.

The bones came into good contact. After a precarious convalescence, and by means of the unwearied attentions of the lady nurse, the boy recovered so as to be able to go to Margate, with firm union of the bone and in fair general health.

The discharge from the sinuses was at all times profuse, and the neighbourhood of the knee-joint was extremely swollen and painful. In January, 1868, an operation was attempted to remove the dead bone, which was evidently the source of irritation; this was unsuccessful, and on 29th January the limb was amputated.

The specimen shows firm bony union, so close that the exact line of union between the femur and tibia is not discernible throughout the whole surface of contact. The cartilaginous epiphysial line is intact and natural in both these bones. The uniting bone-tissue is cancellous in structure, but more firm than the cancellated tissue in the other part of the end of the bone. The tibia and femur were found closely knit together on their outer surfaces by very firm fibrous tissue, probably the remains of the capsule of the knee-joint.

There is reason to believe that not only has there been perfect osseous union between the tibia and femur, but that a growth of new bone has taken place between the two epiphysial lines.

The back of the femur, just above its junction with the tibia, was extensively carious, and was evidently the source of the continued suppuration and irritation of the soft parts, which at last necessitated amputation.

CASE 103.—*The parts removed by amputation from a case in which resection of the knee had been performed eight months previously.*—The patient in this case was seven and a half years old when his joint was resected for a disease of the joint which had lasted eighteen months. At the time of

the operation there was great synovial enlargement and matter was being discharged from several openings communicating with the joint.

On January 7th, 1867, resection was performed by Mr. Smith, in the Children's Hospital. The external wound healed rapidly, except one or two sinuses; the bones, however, though remaining in good position, never united, and eight months after the first operation the limb was amputated, on account of the state of the boy's general health.

The specimen shows the bones in good position and in close contact; the epiphysal cartilages are uninjured by the operation and healthy in appearance.

The texture of the bones seems perfectly natural and healthy. There is no union, either fibrous or bony, between the divided surfaces of the bones; the space, such as it is, is filled with a thin layer of imperfectly organized fibrin.

The cause of the non-union in this case must have been due entirely to the constitutional peculiarities of the patient.

CASE 104.—*The parts removed by amputation from a case in which resection of the knee had been performed ten months previously.*—The parts in this case were removed by amputation by Mr. Paget from a boy whose knee-joint he had resected ten months before. After the operation the bones united firmly, but the discharge remained profuse. On two occasions Mr. Paget attempted, by gouging out carious bone, to remove the source of irritation, and, these operations proving unavailing, about ten days ago he amputated the limb.

The specimen shows a fine bony union between the tibia and femur, and an abundant deposit of new bone on the back of the shaft of the femur. The epiphysal lines of cartilage appear to have been removed in the first operation; the cancellous tissue of the femur is yellow and unhealthy looking.

The real source of all the irritation during life is apparent in a large central necrosis of the cancellous tissue of the head of the tibia. In this bone is a detached sequestrum, about the size and shape of a pigeon's egg. A cloaca is seen leading down to this from the interior surface of the tibia.

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